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(54) APPARATUS, METHOD AND ARTICLE FOR A POWER STORAGE DEVICE COMPARTMENT

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See application file for complete search history.

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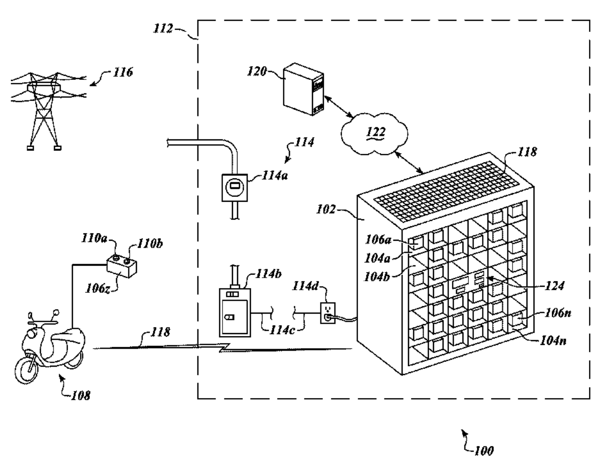
(57) **ABSTRACT**

A network of collection, charging and distribution machines collect, charge and distribute portable electrical energy storage devices (e.g., batteries, supercapacitors or ultracapacitors). To allow easy and convenient access to empty portable electrical energy storage device compartments within the vehicles, if the vehicle comes within the vicinity of a collection, charging and distribution machine or other authorized external device such as a key fob or other wireless device of a user, an empty portable electrical energy storage device compartment that is closed or locked, is unlocked, unlatched or opened automatically. Also, if the portable electrical energy storage device compartment is in another desired state to have the compartment unlocked, such as having a portable electrical energy storage device in the compartment that has a charge level below a particular threshold, the compartment will likewise be unlocked, unlatched or opened automatically.

22 Claims, 9 Drawing Sheets



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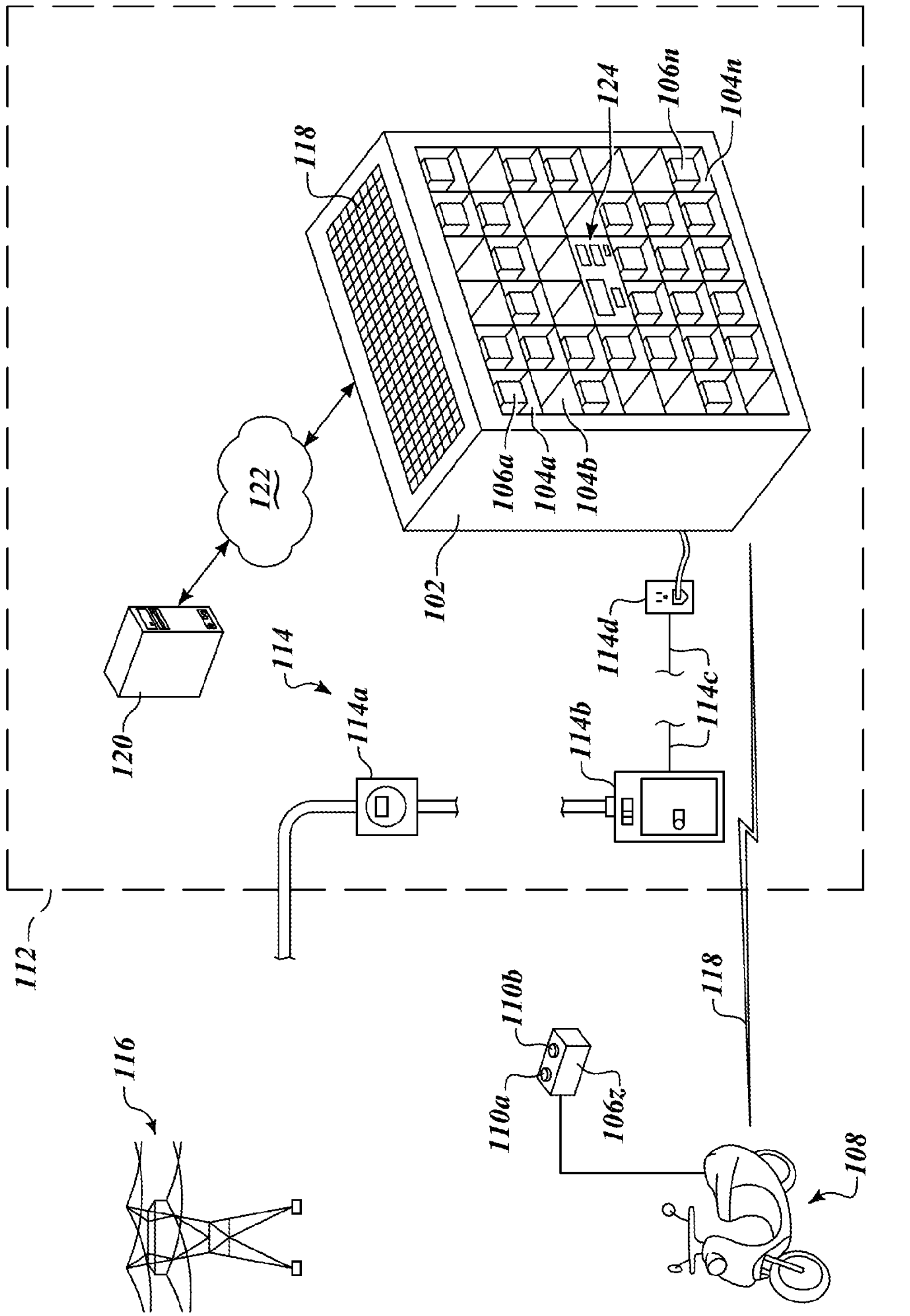

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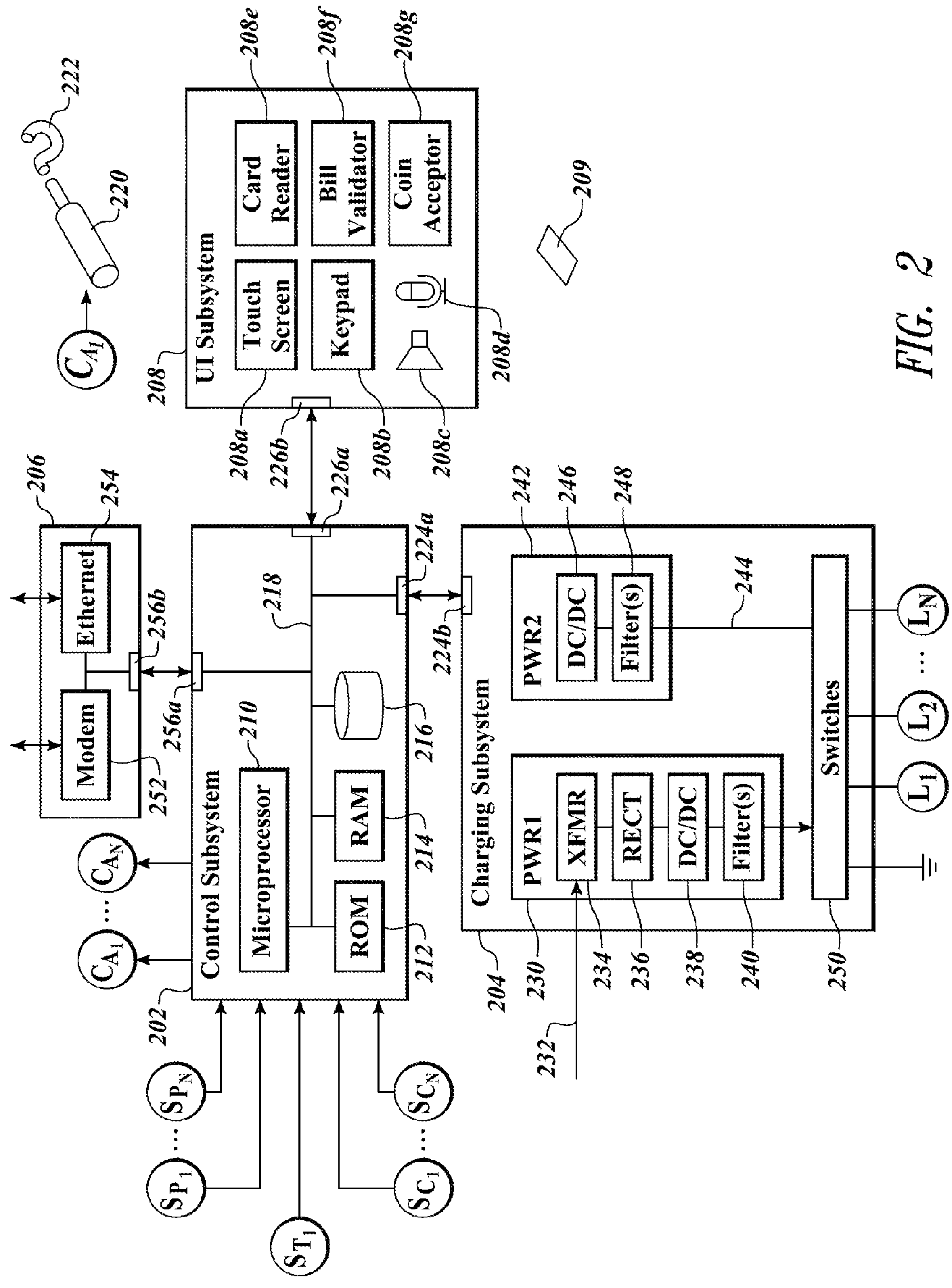
FIG. 1



Control Subsystem
Microprocessor
ROM
RAM
Modem
Ethernet
UI Subsystem
Touch Screen
Keypad
Card Reader
Bill Validator
Coin Acceptor
Charging Subsystem
PWR1
XFMR
RECT
DC/DC
Filter(s)
PWR2
DC/DC
Filter(s)
Switches
202
204
206
208
208a
208b
208c
208d
208e
208f
208g
209
210
212
214
216
218
220
222
224a
224b
226a
226b
230
232
234
236
238
240
242
244
246
248
250
252
254
256a
256b

FIG. 2

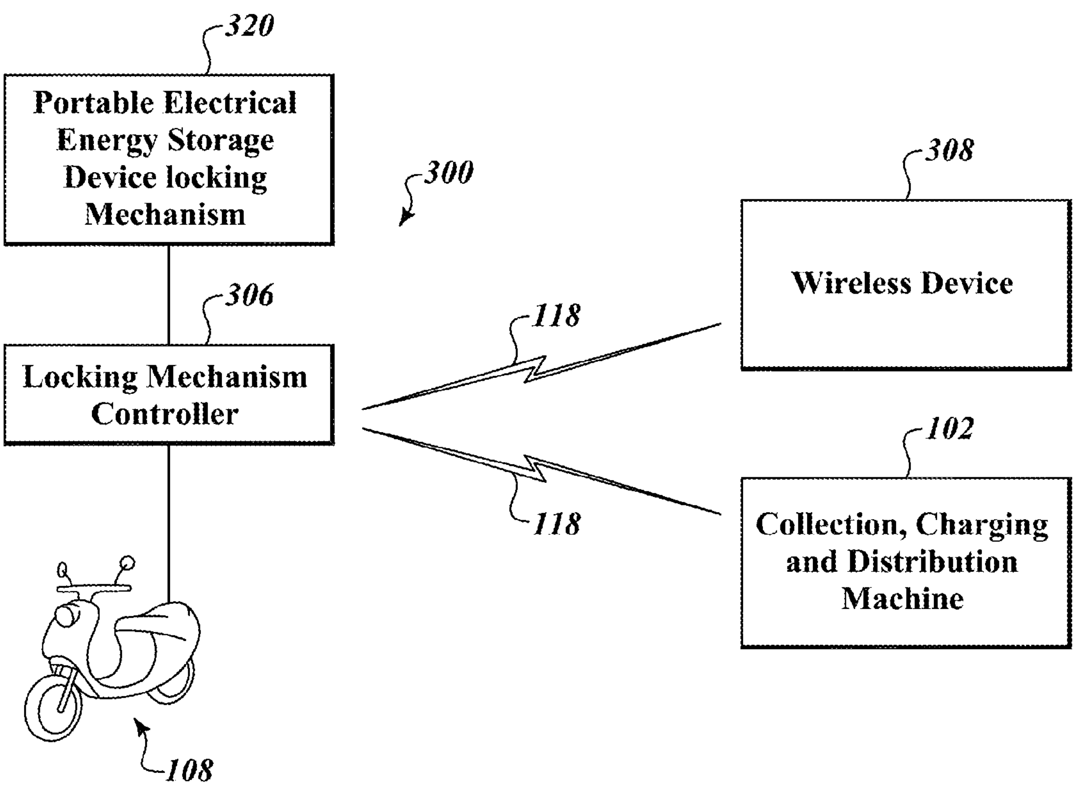
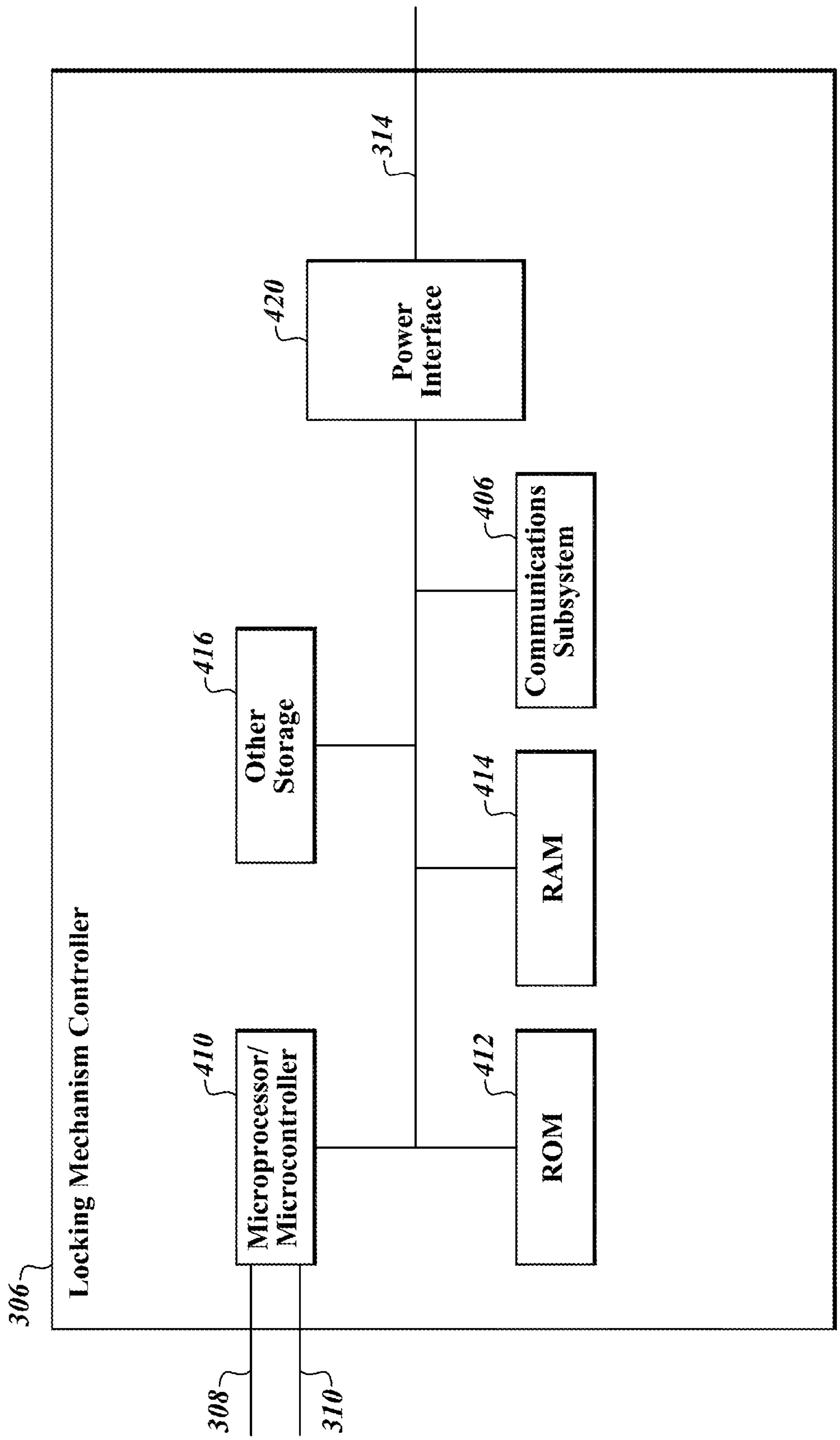

320
Portable Electrical Energy Storage Device locking Mechanism
300
308
Wireless Device
306
Locking Mechanism Controller
118
118
102
Collection, Charging and Distribution Machine
108

FIG. 3



314
420
Power Interface
406
Communications Subsystem
416
Other Storage
414
RAM
412
ROM
410
Microprocessor/ Microcontroller
Locking Mechanism Controller
306
308
310

FIG. 4

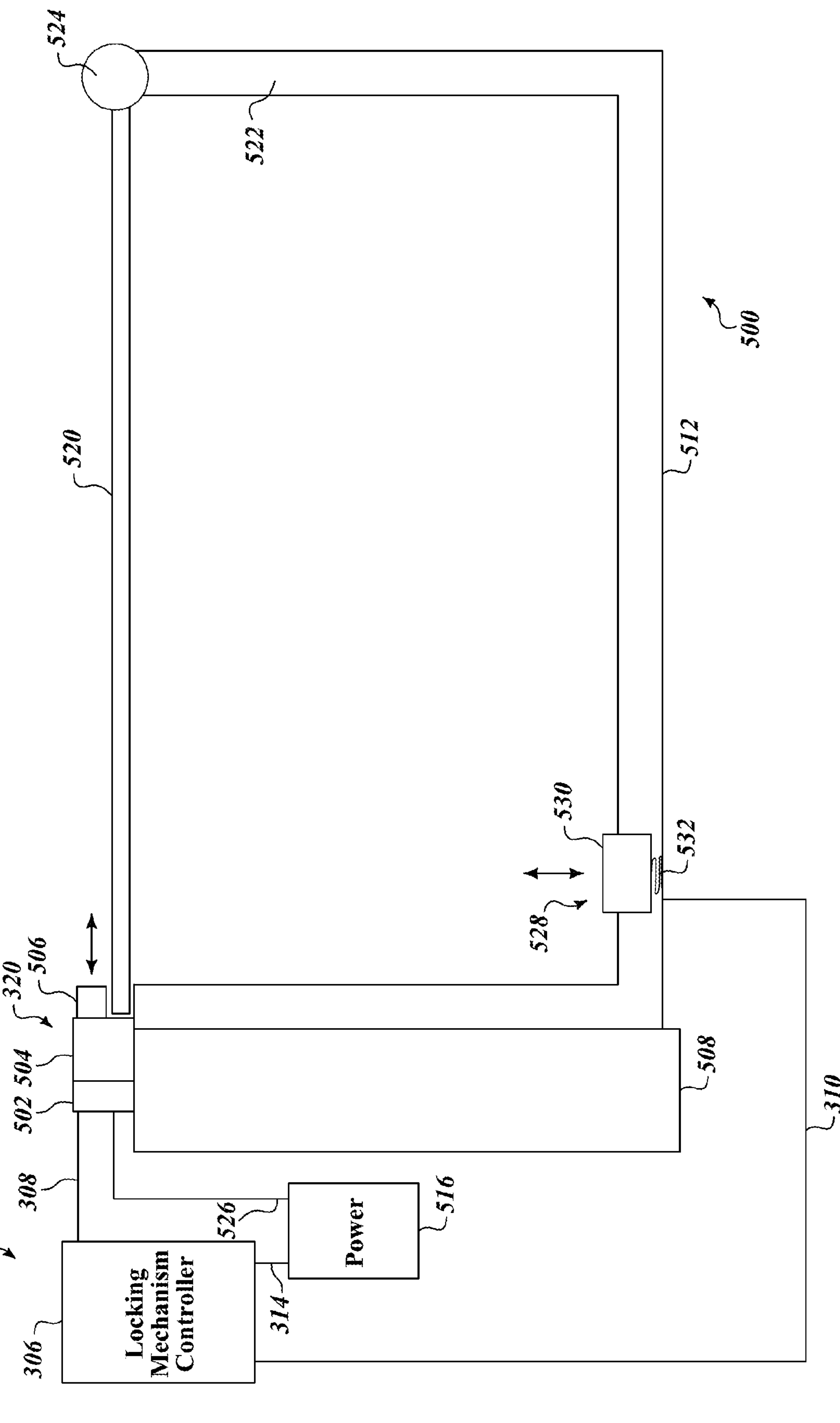

524
522
500
520
512
530
532
528
320
506
504
502
508
310
308
300
526
Power
516
Locking Mechanism Controller
306
314

FIG. 5

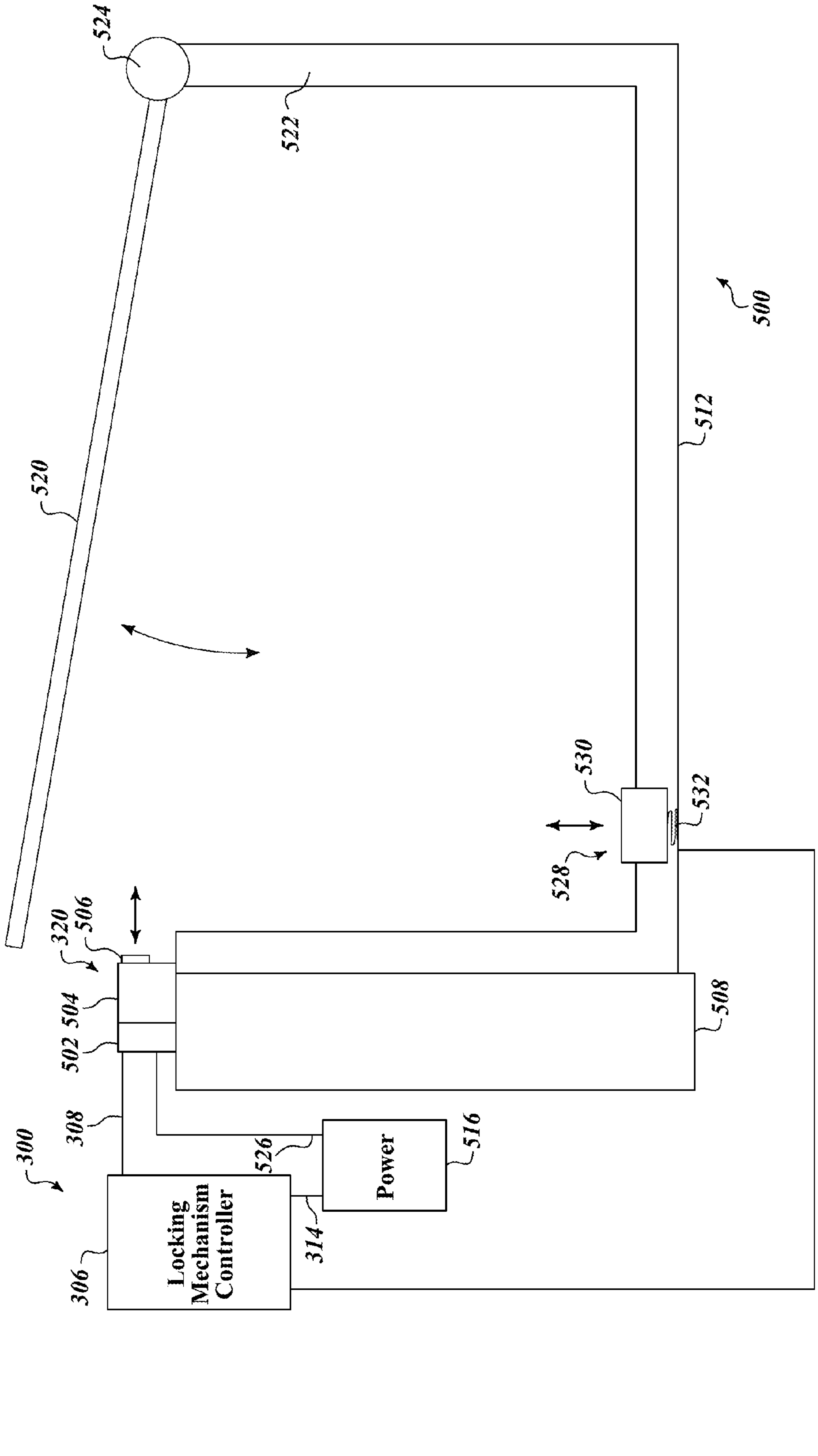

524
522
500
512
520
530
532
528
320
506
504
502
508
308
300
526
516
Power
Locking
Mechanism
Controller
306
314

FIG. 6

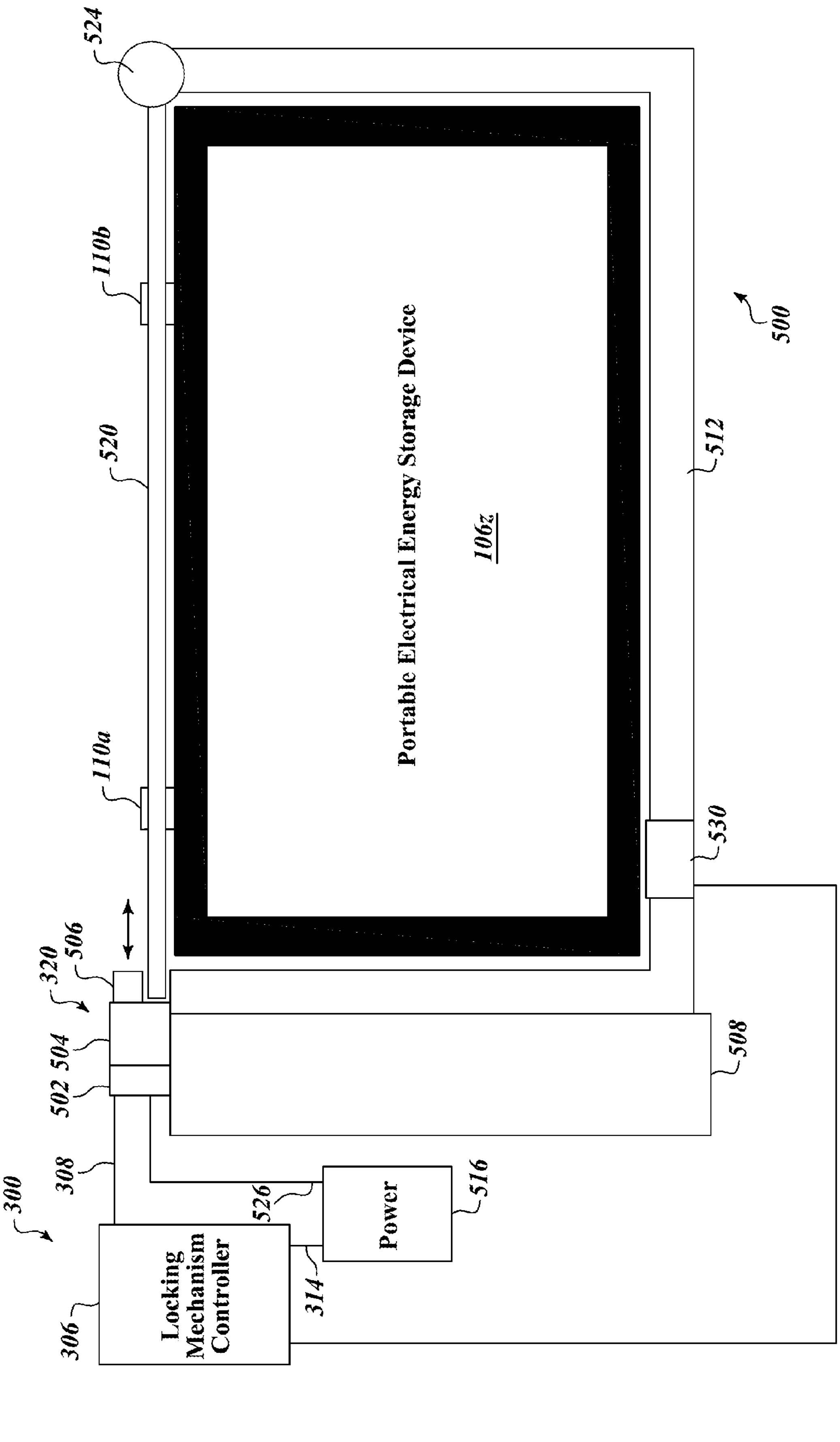

524
110b
520
110a
506
320
504
502
308
300
306
Locking Mechanism Controller
314
526
Power
516
508
530
512
500
Portable Electrical Energy Storage Device
106z

FIG. 7

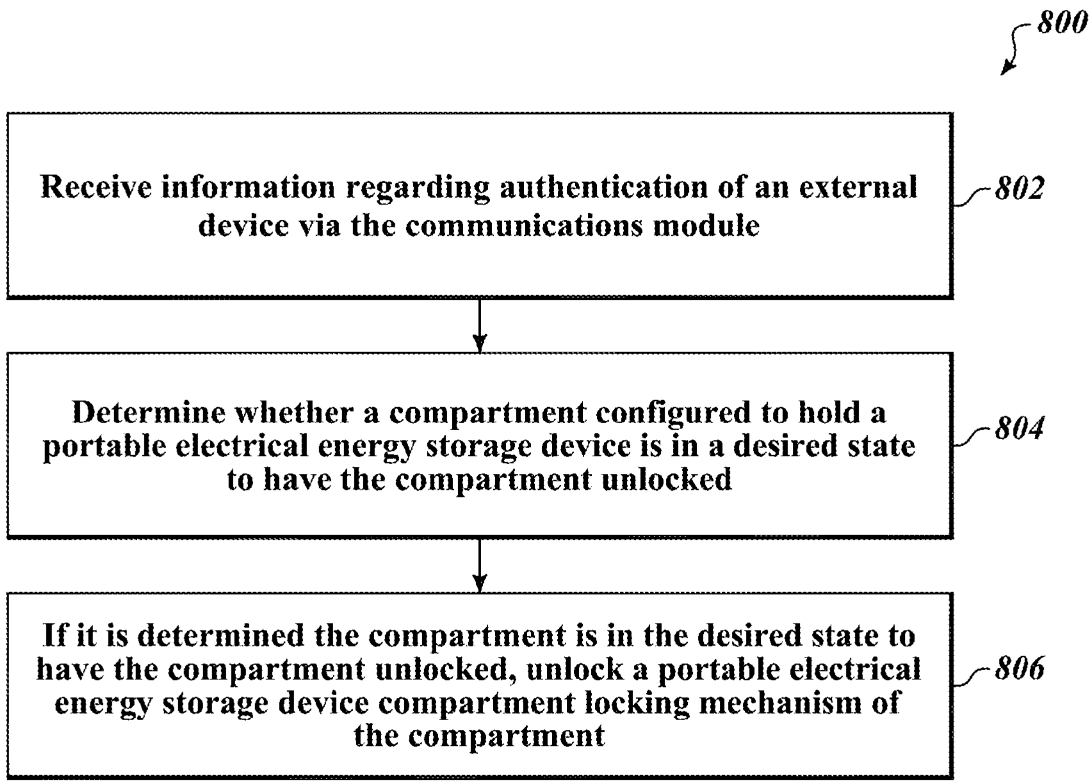

800
Receive information regarding authentication of an external device via the communications module
802
Determine whether a compartment configured to hold a portable electrical energy storage device is in a desired state to have the compartment unlocked
804
If it is determined the compartment is in the desired state to have the compartment unlocked, unlock a portable electrical energy storage device compartment locking mechanism of the compartment
806

FIG. 8

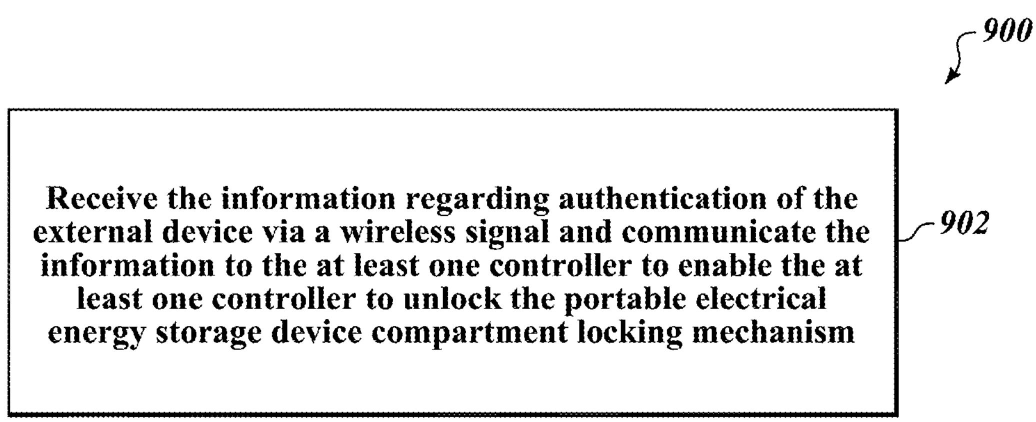

900
Receive the information regarding authentication of the external device via a wireless signal and communicate the information to the at least one controller to enable the at least one controller to unlock the portable electrical energy storage device compartment locking mechanism
902

FIG. 9

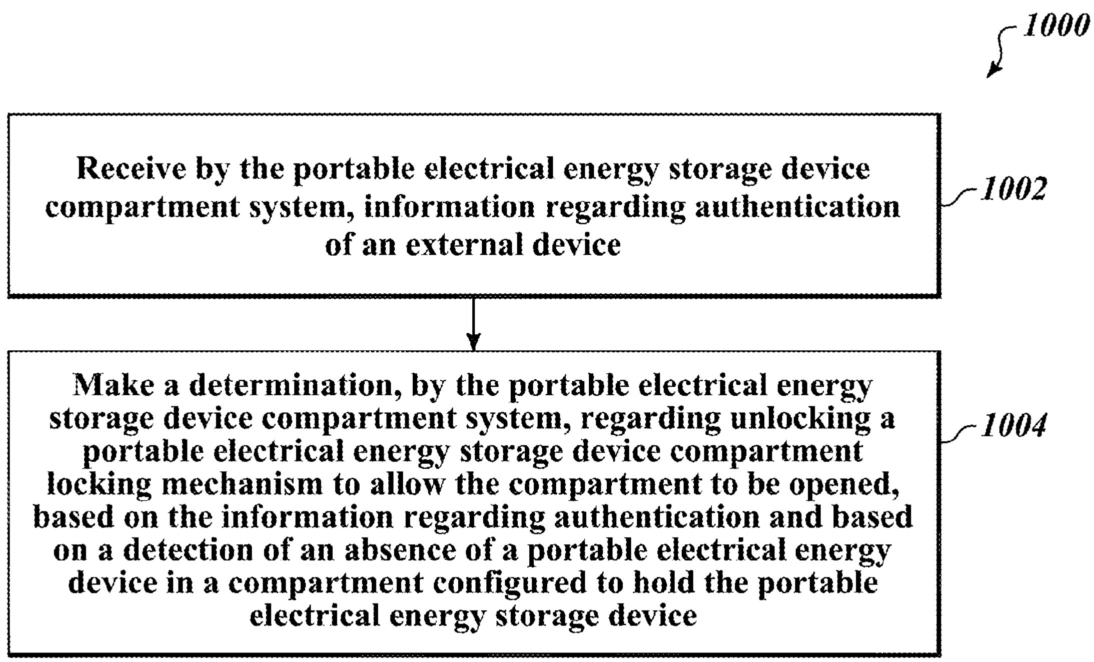

1000
Receive by the portable electrical energy storage device compartment system, information regarding authentication of an external device
1002
Make a determination, by the portable electrical energy storage device compartment system, regarding unlocking a portable electrical energy storage device compartment locking mechanism to allow the compartment to be opened, based on the information regarding authentication and based on a detection of an absence of a portable electrical energy device in a compartment configured to hold the portable electrical energy storage device
1004

FIG. 10

APPARATUS, METHOD AND ARTICLE FOR A POWER STORAGE DEVICE COMPARTMENT

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. 119(e) of the filing date of U.S. provisional patent application Ser. No. 61/511,900 entitled "APPARATUS, METHOD AND ARTICLE FOR COLLECTION, CHARGING AND DISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/647,936 entitled "APPARATUS, METHOD AND ARTICLE FOR COLLECTION, CHARGING AND DISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES" and filed May 16, 2012, U.S. provisional patent application Ser. No. 61/534,753 entitled "APPARATUS, METHOD AND ARTICLE FOR REDISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES, BETWEEN COLLECTION, CHARGING AND DISTRIBUTION MACHINES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/534,761 entitled "APPARATUS, METHOD AND ARTICLE FOR AUTHENTICATION, SECURITY AND CONTROL OF POWER STORAGE DEVICES SUCH AS BATTERIES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/534,772 entitled "APPARATUS, METHOD AND ARTICLE FOR AUTHENTICATION, SECURITY AND CONTROL OF POWER STORAGE DEVICES, SUCH AS BATTERIES, BASED ON USER PROFILES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/511,887 entitled "THERMAL MANAGEMENT OF COMPONENTS IN ELECTRIC MOTOR DRIVE VEHICLES" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/647,941 entitled "THERMAL MANAGEMENT OF COMPONENTS IN ELECTRIC MOTOR DRIVE VEHICLES" and filed May 16, 2012, U.S. provisional patent application Ser. No. 61/511,880 entitled "DYNAMICALLY LIMITING VEHICLE OPERATION FOR BEST EFFORT ECONOMY" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/557,170 entitled "APPARATUS, METHOD, AND ARTICLE FOR PHYSICAL SECURITY OF POWER STORAGE DEVICES IN VEHICLES" and filed Nov. 8, 2011, U.S. provisional patent application Ser. No. 61/581,566 entitled "APPARATUS, METHOD AND ARTICLE FOR A POWER STORAGE DEVICE COMPARTMENT" and filed Dec. 29, 2011, U.S. provisional patent application Ser. No. 61/601,404 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING VEHICLE DIAGNOSTIC DATA" and filed Feb. 21, 2012, U.S. provisional patent application Ser. No. 61/601,949 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING LOCATIONS OF POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINES" and filed Feb. 22, 2012, and U.S. provisional patent application Ser. No. 61/601,953 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING INFORMATION REGARDING AVAILABILITY OF POWER STORAGE DEVICES AT A POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINE" and filed Feb. 22, 2012.

BACKGROUND

1. Technical Field

The present disclosure generally relates to power storage device compartments, and particularly to power storage device compartments in vehicles.

2. Description of the Related Art

There are a wide variety of uses or applications for portable electrical power storage devices.

One such application is in the field of transportation. Hybrid and all-electric vehicles are becoming increasingly common. Such vehicles may achieve a number of advantages over traditional internal combustion engine vehicles. For example, hybrid or electrical vehicles may achieve higher fuel economy and may have little or even zero tail pipe pollution. In particular, all-electric vehicles may not only have zero tail pipe pollution, but may be associated with lower overall pollution. For example, electrical power may be generated from renewable sources (e.g., solar, hydro). Also, for example, electrical power may be generated at generation plants that produce no air pollution (e.g., nuclear plants). Also, for example, electrical power may be generated at generation plants that burn relatively "clean burning" fuels (e.g., natural gas), which have higher efficiency than internal combustion engines, and/or which employ pollution control or removal systems (e.g., industrial air scrubbers) which are too large, costly or expensive for use with individual vehicles.

Personal transportation vehicles such as combustion engine powered scooters and/or motorbikes are ubiquitous in many places, for example, in the many large cities of Asia. Such scooters and/or motorbikes tend to be relatively inexpensive, particularly as compared to automobiles, cars or trucks. Cities with high numbers of combustion engine scooters and/or motorbikes also tend to be very densely populated and suffer from high levels of air pollution. When new, many combustion engine scooters and/or motorbikes provide a relatively low polluting source of personal transportation. For instance, such scooters and/or motorbikes may have higher mileage ratings than larger vehicles. Some scooters and/or motorbikes may even be equipped with basic pollution control equipment (e.g., catalytic converter). Unfortunately, factory specified levels of emission are quickly exceeded if the scooters and/or motorbikes are used and not maintained and/or if the scooters and/or motorbikes are modified, for example, by intentional or unintentional removal of catalytic converters. Often owners or operators of scooters and/or motorbikes lack the financial resources or the motivation to maintain their vehicles.

It is known that air pollution has a negative effect on human health, being associated with causing or exacerbating various diseases (e.g., various reports tie air pollution to emphysema, asthma, pneumonia, and cystic fibrosis, as well as to various cardiovascular diseases). Such diseases take large numbers of lives and severely reduce the quality of life of countless others.

BRIEF SUMMARY

A portable electrical energy storage device compartment system may be summarized as including at least one controller; and at least one communications module coupled to the at least one controller, wherein the at least one controller is configured to: receive information regarding authentication of an external device via the at least one communications module; and in response to receiving the information regarding authentication: determine whether a compartment configured to hold a portable electrical energy storage device is in a desired state to have the compartment unlocked; and if it is determined the compartment is in the desired state to have the compartment unlocked, unlock a portable electrical energy storage device compartment locking mechanism of the compartment.

The desired state to have the compartment unlocked may be a state in which the portable electrical energy storage device is present in the compartment and a charge level of the portable electrical energy storage device is below a particular threshold. The external device may be a portable electrical energy storage device collection and charging machine. The desired state to have the compartment unlocked may be a state in which the portable electrical energy storage device is not present in the compartment. The at least one communications module may be configured to receive the information regarding authentication of the external device via a wireless signal and communicate the information to the at least one controller to enable the at least one controller to unlock the portable electrical energy storage device compartment locking mechanism.

The portable electrical energy storage device compartment system may further include the portable electrical energy storage device compartment locking mechanism coupled to the at least one controller; and a detection device coupled to the at least one controller and the compartment, the detection device configured to be activated by the portable electrical energy storage device being present in the compartment, wherein the at least one controller may be configured to send a control signal in a manner to unlock the portable electrical energy storage device compartment locking mechanism in order to allow the compartment to be opened, if the external device is authenticated based on the information regarding authentication.

The at least one controller may be further configured to make a determination regarding unlocking the portable electrical energy storage device compartment locking mechanism based on the received information regarding authentication. The least one controller may be further configured to: generate a challenge key to send to the external device; send the challenge key to the external device; receive a response from the external device to the sending of the challenge key, the response including a response code as part of the information regarding authentication; generate an output from a secret algorithm using a secret key and the response code as input, the secret algorithm and the secret key configured to be known only to the portable electrical energy storage device compartment system and one or more authorized external devices; and comparing the output from the secret algorithm to the response code, and wherein the at least one controller may be configured to make the determination regarding unlocking the portable electrical energy storage device compartment locking mechanism based at least on the comparison. The configured portable electrical energy storage device compartment system may be coupled to a vehicle. The external device may be a key fob. The external device may be a wireless portable electronic device. The external device may be a device located at a vehicle service center. The at least one controller may be configured to receive the information regarding authentication via a wireless signal transmitted from the external device, and the wireless signal transmitted from the external device may not be detectable outside a specified maximum range from the at least one communications module. The wireless signal may include a rolling code for the authentication of the external device by the at least one controller.

The portable electrical energy storage device compartment system may further include a power source coupled to the at least one controller and the portable electrical energy storage device compartment locking mechanism to provide power to the portable electrical energy storage device compartment locking mechanism.

A method of operating a portable electrical energy storage device compartment system may be summarized as including receiving, by the portable electrical energy storage device compartment system, information regarding authentication of an external device; and making a determination, by the portable electrical energy storage device compartment system, regarding unlocking a portable electrical energy storage device compartment locking mechanism, based on the information regarding authentication and based on a detection of an absence of a portable electrical energy storage device in a compartment configured to hold the portable electrical energy storage device.

The method of operating a portable electrical energy storage device compartment may further include detecting the absence of the portable electrical energy storage device in the compartment by determining that the portable electrical energy storage device is not present in the compartment based on an absence of a signal from a detection device coupled to the compartment configured to be activated by the presence of the portable electrical energy storage device in the compartment.

The receiving the information regarding authentication may include receiving the information regarding authentication via a wireless signal transmitted from a portable wireless electronic device, and the wireless signal received from the portable wireless electronic device may not be detectable outside a specified maximum range from a communications module of the portable electrical energy storage device compartment system. The portable electrical energy storage device compartment system may be coupled to a vehicle to which the portable electrical energy storage device is configured to provide power when the portable electrical energy storage device is present in the compartment. The making the determination may include comparing a code from the received information regarding authentication to one or more codes associated with the portable electrical energy storage device compartment system and may further include unlocking the portable electrical energy storage device compartment locking mechanism to allow the compartment to be opened if the code from the received information regarding authentication matches one of the one or more codes associated with the portable electrical energy storage device compartment system and there is an absence of the portable electrical energy storage device in the compartment detected.

The method of operating a portable electrical energy storage device compartment may further include automatically lifting a lid of the compartment if the code from the received information regarding authentication matches the one of the one or more codes associated with the portable electrical energy storage device compartment system and there is an absence of the portable electrical energy storage device in the compartment detected.

A portable electrical energy storage device compartment may be summarized as including a housing configured to hold a portable electrical energy storage device; a power source; and a portable electrical energy storage device compartment locking system coupled to the power source and the housing configured to allow the compartment to be opened based on information regarding authentication of an external device received wirelessly from the external device and based on a detection of at least one of: an absence of a portable electrical energy storage device in the housing and a charge level of the portable electrical energy storage device in the housing.

The portable electrical energy storage device compartment locking system may include at least one controller; and at least one communications module coupled to the at least one controller, the at least one controller may be configured to: receive the information regarding authentication of an external device via the at least one communications module; receive information regarding the detection of an absence of a portable electrical energy storage device in the housing; and make a determination regarding unlocking the portable electrical energy storage device compartment locking system to allow the compartment to be opened based on the received information regarding authentication of an external device via the at least one communications module and based on the received information regarding the detection of an absence of a portable electrical energy storage device in the housing.

The housing may be configured to hold the portable electrical energy storage device coupled to a vehicle to which the portable electrical energy storage device is configured to provide power when the portable electrical energy storage device is present in the housing.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In the drawings, identical reference numbers identify similar elements or acts. The sizes and relative positions of elements in the drawings are not necessarily drawn to scale. For example, the shapes of various elements and angles are not drawn to scale, and some of these elements are arbitrarily enlarged and positioned to improve drawing legibility. Further, the particular shapes of the elements as drawn are not intended to convey any information regarding the actual shape of the particular elements, and have been solely selected for ease of recognition in the drawings.

FIG. **1** is a schematic view of a collection, charging and distribution machine along with a number of electrical power storage devices according to one non-limiting illustrated embodiment, along with an electric scooter or motorbike having an electrical power storage device compartment, and an electrical service provided via an electrical grid.

FIG. **2** is a block diagram of the collection, charging and distribution machine of FIG. **1**, according to one non-limiting illustrated embodiment.

FIG. **3** is a block diagram of a portable electrical energy storage device compartment locking system for the portable electrical energy storage device of the scooter or motorbike of FIG. **1** in wireless communication in one instance with the collection, charging and distribution machine of FIG. **1** and in another instance with an external wireless device, according to one non-limiting illustrated embodiment.

FIG. **4** is a schematic view of the locking mechanism controller of FIG. **3**, according to one non-limiting illustrated embodiment.

FIG. **5** is a cross-sectional elevation view of a locked, empty portable electrical energy storage device compartment configured to hold the portable electrical energy storage device of FIG. **1** and FIG. **3** coupled to the portable electrical energy storage device compartment locking system of FIG. **3**, according to one non-limiting illustrated embodiment.

FIG. **6** is a cross-sectional elevation view of the empty portable electrical energy storage device compartment of FIG. **5** in an unlocked and open state, according to one non-limiting illustrated alternative embodiment.

FIG. **7** is a cross-sectional elevation view of the portable electrical energy storage device compartment of FIG. **5** in a locked state holding the portable electrical energy storage device of FIG. **1** and FIG. **3**, according to one non-limiting illustrated alternative embodiment

FIG. **8** is a flow diagram showing a high level method of operating the locking mechanism controller of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment.

FIG. **9** is a flow diagram showing a low level method of operating the locking mechanism controller of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment, including communicating information to unlock the portable electrical energy storage device compartment locking mechanism, useful in the method of FIG. **8**.

FIG. **10** is a flow diagram showing a high level method of operating the portable electrical energy storage device compartment system of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment.

DETAILED DESCRIPTION

In the following description, certain specific details are set forth in order to provide a thorough understanding of various disclosed embodiments. However, one skilled in the relevant art will recognize that embodiments may be practiced without one or more of these specific details, or with other methods, components, materials, etc. In other instances, well-known structures associated with vending apparatus, batteries, locking mechanisms, wireless technologies, supercapacitors or ultracapacitors, power converters including but not limited to transformers, rectifiers, DC/DC power converters, switch mode power converters, controllers, and communications systems and structures and networks have not been shown or described in detail to avoid unnecessarily obscuring descriptions of the embodiments.

Unless the context requires otherwise, throughout the specification and claims which follow, the word "comprise" and variations thereof, such as "comprises" and "comprising" are to be construed in an open, inclusive sense that is as "including, but not limited to."

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment.

The use of ordinals such as first, second and third does not necessarily imply a ranked sense of order, but rather may only distinguish between multiple instances of an act or structure.

Reference to portable electrical power storage devices means any device capable of storing electrical power and releasing stored electrical power including but not limited to batteries, supercapacitors or ultracapacitors. Reference to batteries means chemical storage cell or cells, for instance rechargeable or secondary battery cells including but not limited to nickel cadmium alloy or lithium ion battery cells.

The headings and Abstract of the Disclosure provided herein are for convenience only and do not interpret the scope or meaning of the embodiments.

FIG. **1** shows an environment **100** including a collection, charging and distribution machine **102**, according to one illustrated embodiment.

The collection, charging and distribution machine **102** may take the form of a vending machine or kiosk. The collection, charging and distribution machine **102** has a plurality of receivers, compartments or receptacles **104***a*, **104***b*-**104***n* (only three called out in FIG. **1**, collectively **104**) to removably receive portable electrical energy storage devices (e.g., batteries, supercapacitors or ultracapacitors) **106***a*-**106***n* (collectively **106**) for collection, charging and distribution. As illustrated in FIG. **1**, some of the receivers **104** are empty, while other receivers **104** hold portable electrical energy storage devices **106**. While FIG. **1** shows a single portable electrical energy storage device **106** per receiver **104**, in some embodiments each receiver **104** may hold two or even more portable electrical energy storage devices **106**. For example, each of the receivers **104** may be sufficiently deep to receive three portable electrical energy storage devices **106**. Thus, for example, the collection, charging and distribution machine **102** illustrated in FIG. **1** may have a capacity capable of simultaneously holding 40, 80 or 120 portable electrical energy storage devices **106**.

The portable electrical energy storage devices **106** may take a variety of forms, for example batteries (e.g., array of battery cells) or supercapacitors or ultracapacitors (e.g., array of ultracapacitor cells). For example, the portable electrical energy storage device **106**z may take the form of rechargeable batteries (i.e., secondary cells or batteries). The portable electrical energy storage device **106**z may, for instance, be sized to physically fit, and electrically power, personal transportation vehicles, such as all-electric scooters or motorbikes **108**, and may also be sized to physically fit in a portable electrical energy storage device compartment of the all-electric scooters or motorbikes **108**. As previously noted, combustion engine scooters and motorbikes are common in many large cities, for example in Asia, Europe and the Middle East. The ability to conveniently access charged batteries throughout a city or region may facilitate the use of all-electric scooters and motorbikes **108** in place of combustion engine scooters and motorbikes, thereby alleviating air pollution, as well as reducing noise.

The portable electrical energy storage devices **106** (only visible for portable electrical energy storage device **106**z) may include a number of electrical terminals **110**a, **110**b (two illustrated, collectively **110**), accessible from an exterior of the portable electrical energy storage device **106**z and also may be accessible when the portable electrical energy storage device **106**z is in a portable electrical energy storage device compartment of the all-electric scooters or motorbikes **108**. The electrical terminals **110** allow charge to be delivered from the portable electrical energy storage device **106**z, as well as allow charge to be delivered to the portable electrical energy storage device **106**z for charging or recharging the same. While illustrated in FIG. **1** as posts, the electrical terminals **110** may take any other form which is accessible from an exterior of the portable electrical energy storage device **106**z and a portable electrical energy storage device compartment, including electrical terminals positioned within slots in a battery housing and a portable electrical energy storage device compartment. As the portable electrical energy storage devices **106** may be lent, leased, and/or rented out to the public, it is desirable to control how and in what circumstances the portable electrical energy storage device compartment for the portable electrical energy storage devices **106** may be accessed. This control of the access to the portable electrical energy storage device compartments of the portable electrical energy storage devices **106** helps to prevent theft and/or misuse of the portable electrical energy storage devices **106** and also provides for convenient access to the portable electrical energy storage device **106**z when replacing or putting a new portable electrical energy storage device **106**z in the scooter or motorbike **108**. Systems and methods for the operation of a portable electrical energy storage device compartment, including systems for controlling when the portable electrical energy storage device compartment is to be automatically unlocked or unlatched, are described in more detail below with reference to FIGS. **3**-**9**, and are useful in the overall system for collection, charging and distribution of the portable electrical energy storage devices **106** described herein.

The collection, charging and distribution machine **102** is positioned at some location **112** at which the collection, charging and distribution machine **102** is conveniently and easily accessible by various end users. The location may take any of a large variety of forms, for example, a retail environment such as a convenience store, supermarket, gas or petrol station, or service or service center. Alternatively, the collection, charging and distribution machine **102** may stand alone at a location **112** not associated with an existing retail or other business, for example in public parks or other public places. Thus, for example, collection, charging and distribution machines **102** may be located at each store of a chain of convenience stores throughout a city or region. Such may advantageously rely on the fact that convenience stores are often sited or distributed based on convenience to the target population or demographic. Such may advantageously rely on pre-existing leases on storefronts or other retail locations to allow an extensive network of collection, charging and distribution machines **102** to be quickly developed in a city or region. Quickly achieving a large network that provides for convenient replacement and security of the of portable electrical energy storage devices **106** used in the all-electric scooters or motorbikes **108** enhances the ability to depend on such a system and likely commercial success of such an effort.

The location **112** may include an electrical service **114** to receive electrical power from a generating station (not shown) for example via a grid **116**. The electrical service **114** may, for example, include one or more of an electrical service meter **114**a, a circuit panel (e.g., circuit breaker panel or fuse box) **114**b, wiring **114**c, and electrical outlet **114**d. Where the location **112** is an existing retail or convenience store, the electrical service **114** may be an existing electrical service, so may be somewhat limited in rating (e.g., 120 volts, 240 volts, 220 volts, 230 volts, 15 amps).

Optionally, the collection, charging and distribution machine **102** may include or be coupled to a source of renewable electrical power. For example, where installed in an outside location the collection, charging and distribution machine **102** may include an array of photovoltaic (PV) cells **118** to produce electrical power from solar insolation. Alternatively, the collection, charging and distribution machine **102** may be electrically coupled to a microturbine (e.g., wind turbine) or PV array positioned elsewhere at the location **112**, for instance on a roof top or mounted at a top of a pole (not shown).

The collection, charging and distribution machine **102** may be communicatively coupled to one or more remotely located computer systems, such as back end or back office systems (only one shown) **120**. The back end or back office systems **120** may collect data from and/or control a plurality of collection, charging and distribution machines **102** distributed about an area, such as a city. In some embodiments, the back end or back office systems **120** may collect data from and/or control a plurality of the portable electrical energy storage devices **106**, such as by generating, tracking, sending and/or receiving one or more codes included in a wireless signal **118** sent by the collection, charging and distribution machine **102** to an all-electric scooter or motorbike **108** or other vehicle. The sending and/or receiving one or more codes enables access to the portable electrical energy storage device compartments of the portable electrical energy storage devices **106** for placing a portable electrical energy storage device **106**z in a respective all-electric scooter or motorbike **108** while the all-electric scooter or motorbike **108** is in the vicinity of the collection, charging and distribution machine **102** or other authorized external device. The communications between the back end or back office systems **120** and the collection, charging and distribution machine **102** may occur over one or more communications channels including one or more networks **122**, or non-networked communications channels. Communications may be over one or more wired communications channels (e.g., twisted pair wiring, optical fiber), wireless communications channels (e.g., radio, microwave, satellite, 801.11 compliant). Networked communications channels may include one or more local area networks (LANs), wide area networks (WANs), extranets, intranets, or the Internet including the World Wide Web portion of the Internet.

The collection, charging and distribution machine **102** may include a user interface **124**. The user interface may include a variety of input/output (I/O) devices to allow an end user to interact with the collection, charging and distribution machine **102**. Various I/O devices are called out and described in reference to FIG. **2**, which follows.

FIG. **2** shows the collection, charging and distribution machine **102** of FIG. **1**, according to one illustrated embodiment.

The collection, charging and distribution machine **102** includes a control subsystem **202**, a charging subsystem **204**, a communications subsystem **206**, and a user interface subsystem **208**.

The control subsystem **202** includes a controller **210**, for example a microprocessor, microcontroller, programmable logic controller (PLC), programmable gate array (PGA), application specific integrated circuit (ASIC) or another controller capable of receiving signals from various sensors, performing logical operations, and sending signals to various components. Typically, the controller **210** may take the form of a microprocessor (e.g., INTEL, AMD, ATOM). The control subsystem **202** may also include one or more non-transitory processor- or computer-readable storage media, for example read-only memory (ROM) **212**, random access memory (RAM) **214**, and data store **216** (e.g., solid-state storage media such as flash memory or EEPROM, or spinning storage media such as hard disk). The non-transitory processor- or computer-readable storage media **212**, **214**, **216** may be in addition to any non-transitory storage medium (e.g., registers) which is part of the controller **210**. The control subsystem **202** may include one or more buses **218** (only one illustrated) coupling various components together, for example one or more power buses, instruction buses, data buses, etc.

As illustrated, the ROM **212**, or some other one of the non-transitory processor- or computer-readable storage media **212**, **214**, **216**, stores instructions and/or data or values for variables or parameters. The sets of data may take a variety of forms, for example a lookup table, a set of records in a database, etc. The instructions and sets of data or values are executable by the controller **210**. Execution of the instructions and sets of data or values causes the controller **210** to perform specific acts to cause the collection, charging and distribution machine **102** to collect, charge, and distribute portable energy storage devices, and to send one or more signals that enable access to the portable electrical energy storage device compartments of the scooters or motorbikes **108** while the scooters or motorbikes **108** are in the vicinity of a collection, charging and distribution machine **102**. Specific operation of the collection, charging and distribution machine **102** is described herein and also below with reference to FIG. **3** and various flow diagrams (FIGS. **8-10**) in the context of being an external device which is authenticated in order to allow access to the portable electrical energy storage device compartment (shown in FIGS. **5-7**).

The controller **210** may use RAM **214** in a conventional fashion, for volatile storage of instructions, data, etc. The controller **210** may use data store **216** to log or retain information, for example one or more codes that enable access to the portable electrical energy storage device compartment while the scooter or motorbike **108** is in the vicinity of the collection, charging and distribution machine **102**, and/or information related to operation of the collection, charging and distribution machine **102** itself. The instructions are executable by the controller **210** to control operation of the collection, charging and distribution machine **102** in response to end user or operator input, and using data or values for the variables or parameters.

The control subsystem **202** receives signals from various sensors and/or other components of the collection, charging and distribution machine **102** which include information that characterizes or is indicative of operation, status, or condition of such other components. Sensors are represented in FIG. **2** by the letter S appearing in a circle along with appropriate subscript letters.

For example, one or more position sensors S_{P1}-S_{PN} may detect the presence or absence of a portable electrical power storage device **106** at each of the receivers **104**. The position sensors S_{P1}-S_{PN} may take a variety of forms. For example, the position sensors S_{P1}-S_{PN} may take the form of mechanical switches that are closed, or alternatively opened, in response to contact with a portion of a respective portable electrical power storage device **106** when the portable electrical power storage device **106** is inserted into the receiver **104**. Also for example, the position sensors S_{P1}-S_{PN} may take the form of optical switches (i.e., optical source and receiver) that are closed, or alternatively opened, in response to contact with a portion of a respective portable electrical power storage device **106** when the portable electrical power storage device **106** is inserted into the receiver **104**. Also for example, the position sensors S_{P1}-S_{PN} may take the form of electrical sensors or switches that are closed, or alternatively opened, in response to detecting a closed circuit condition created by contact with the terminals **110** of a respective portable electrical power storage device **106** when the portable electrical power storage device **106** is inserted into the receiver **104**, or an open circuit condition that results from the lack of a respective portable electrical power storage device **106** in the receiver **104**. These examples are intended to be non-limiting, and it is noted that any other structures and devices for detecting the presence/absence or even the insertion of the portable electrical power storage devices **106** into receivers may be employed.

For example, one or more charge sensors S_{C1}-S_{CN} may detect charge of the portable electrical power storage devices **106** at each of the receivers **104**. Charge sensors S_{C1}-S_{CN} may detect the amount of charge stored by the portable electrical power storage devices **106**. Charge sensors S_{C1}-S_{CN} may additionally detect an amount of charge and/or rate of charging being supplied to ones of the portable electrical power storage devices **106** at each of the receivers **104**. Such may allow assessment of current (i.e., temporal) charge condition or status of each portable electrical power storage device **106**, as well as allow feedback control over charging of same, including control over rate of charging. Charge sensors S_{C1}-S_{CN} may include any variety of current and/or voltage sensors.

For example, one or more charge sensors S_{T1} (only one shown) may detect or sense a temperature at the receivers **104** or in the ambient environment.

The control subsystem **202** provides signals to various actuators and/or other components responsive to control signals, which signals include information that characterizes or is indicative of an operation the component is to perform or a state or condition into which the components should enter. Control signals, actuators or other components responsive to control signals are represented in FIG. **2** by the letter C appearing in a circle along with appropriate subscript letters.

For example, one or more engine control signals C_{A1}-C_{AN} may affect the operation of one or more actuators **220** (only one illustrated). For instance, a control signal C_{A1} may cause movement of an actuator **220** between a first and a second position or change a magnetic field produced by the actuator **220**. The actuator **220** may take any of a variety of forms, including but not limited to a solenoid, an electric motor such as a stepper motor, or an electromagnet. The actuator **220** may be coupled to operate a latch, lock or other retainer mechanism **222**. The latch, lock or other retainer mechanism **222** may selectively secure or retain one or more portable electrical power storage devices **106** (FIG. **1**) in the receiver **104** (FIG. **1**). For instance, the latch, lock or other retainer mechanism **222** may physically couple to a complimentary structure that is part of a housing of the portable electrical power storage devices **106** (FIG. **1**). Alternatively, the latch, lock or other retainer mechanism **222** may magnetically couple to a complimentary structure that is part of a housing of the portable electrical power storage devices **106** (FIG. **1**). Also for instance, the latch, lock or other retainer mechanism **222** may open a receiver **104** (FIG. **1**), or may allow a receiver **104** to be opened, to receive a partially or fully discharged portable electrical power storage device **106** for charging. For example, the actuator may open and/or close a door to the receiver **104** (FIG. **1**), to selectively provide access to a portable electrical power storage device **106** (FIG. **1**) received therein. Also for example, the actuator may open and/or close a latch or lock, allowing an end user to open and/or close a door to the receiver **104** (FIG. **1**), to selectively provide access to a portable electrical power storage device **106** (FIG. **1**) received therein.

The control subsystem **202** may include one or more ports **224*a*** to provide control signals to one or more ports **224*b*** of the charging subsystem **204**. The ports **224*a***, **224*b*** may provide bi-directional communications. The control subsystem **202** may include one or more ports **226*a*** to provide control signals to one or more ports **226*b*** of the user interface subsystem **208**. The ports **226*a***, **226*b*** may provide bi-directional communications.

The charging subsystem **204** includes various electrical and electronic components to charge portable electrical power storage devices **106** when positioned or received in the receivers **104**. For example, the charging subsystem **204** may include one or more power buses or power bus bars, relays, contactors or other switches (e.g., insulated gate bipolar transistors or IGBTs, metal oxide semiconductor transistors or MOSFETs), rectifier bridge(s), current sensors, ground fault circuitry, etc. The electrical power is supplied via contacts that can take any of a variety of forms, for instance terminals, leads, posts, etc. The contacts allow electrical coupling of various components. Some possible implementations are illustrated in FIG. **2**. Such is not intended to be exhaustive. Additional components may be employed while other components may be omitted.

The illustrated charging subsystem **204** includes a first power converter **230** that receives electrical power from the electrical service **114** (FIG. **1**) via a line or cord **232**. The power will typically be in the form of single two- or three-phase AC electrical power. As such, the first power converter **230** may need to convert and otherwise condition the electrical power received via the electrical services **114** (FIG. **1**), for example for rectifying an AC waveform to DC, transforming voltage, current, and phase, as well as reducing transients and noise. Thus, the first power converter **230** may include a transformer **234**, rectifier **236**, DC/DC power converter **238**, and filter(s) **240**.

The transformer **234** may take the form of any variety of commercially available transformers with suitable ratings for handling the power received via the electrical service **114** (FIG. **1**). Some embodiments may employ multiple transformers. The transformer **234** may advantageously provide galvanic isolation between the components of the collection, charging and distribution machine **102** and the grid **116** (FIG. **1**). The rectifier **236** may take any of variety of forms, for example a full bridge diode rectifier or a switch mode rectifier. The rectifier **236** may be operated to transform AC electrical power to DC electrical power. The DC/DC power converter **238** may take any of a large variety of forms. For example, DC/DC power converter **238** may take the form a switch mode DC/DC power converter, for instance employing IGBTs or MOSFETs in a half or full bridge configuration, and may include one or more inductors. The DC/DC power converter **238** may have any number of topologies including a boost converter, buck converter, synchronous buck converter, buck-boost converter or fly-back converter. The filter(s) **240** may include one or more capacitors, resistors, Zener diodes or other elements to suppress voltage spikes, or to remove or reduce transients and/or noise.

The illustrated charging subsystem **204** may also receive electrical power from a renewable power source, for example the PV array **118** (FIG. **1**). Such may be converted or conditioned by the first power converter **230**, for example being supplied directly to the DC/DC power converter **238**, bypassing the transformer **236** and/or rectifier **236**. Alternatively, the illustrated charging subsystem **204** may include a dedicated power converter to convert or otherwise condition such electrical power.

The illustrated charging subsystem **204** may optionally include second power converter **242** that receives electrical power from one or more portable electrical power storage devices **106** (FIG. **1**) via one or more lines **244**, for charging other ones of the portable electrical power storage devices **106**. As such, the second power converter **242** may need to convert and/or otherwise condition the electrical power received from portable electrical power storage devices **106**, for example optionally transforming voltage or current, as well as reducing transients and noise. Thus, the second power converter **242** may optionally include a DC/DC power converter **246** and/or filter(s) **248**. Various types of DC/DC power converters and filters are discussed above.

The illustrated charging subsystem **204** includes a plurality of switches **250** responsive to the control signals delivered via ports **224*a***, **224*b*** from the control subsystem **202**. The switches may be operable to selectively couple a first number or set of portable electrical power storage devices **106** to be charged from electrical power supplied by both the electrical service via the first power converter **230** and from electrical power supplied by a second number or set of portable electrical power storage devices **106**. The first number or set of portable electrical power storage devices **106** may include a single portable electrical power storage device **106**, two, or even more portable electrical power storage devices **106**. The second number or set of portable electrical power storage devices **106** may include a single portable electrical power storage device **106**, two, or even more portable electrical power storage devices **106**. The portable electrical power storage devices **106** are represented in FIG. **2** as loads L_1, L_2-L_N.

The communications subsystem **206** may additionally include one or more communications modules or components which facilitate communications with the various components of a back end or back office system **120** (FIG. **1**), various components of the all-electric scooter or motorbike **108**, various components of the portable electrical power storage devices **106**, and/or various components of a portable electrical energy storage device compartment of the all-electric scooter or motorbike **108**. The communications subsystem **206** may, for example, include one or more modems **252** and/or one or more Ethernet cards or other types of communications cards or components **254**. A port **256***a* of the control subsystem **202** may communicatively couple the control subsystem **202** with a port **256***b* of the communications subsystem **206**. The communications subsystem **206** may provide wired and/or wireless communications. For example, the communications subsystem **206** may provide components enabling short range (e.g., via Bluetooth, near field communication (NFC), radio frequency identification (RFID) components and protocols) or longer range wireless communications (e.g., over a wireless LAN, satellite, or cellular network) with various other devices external to the collection, charging and distribution machine **102**, including various components of the all-electric scooter or motorbike **108**, various components of the portable electrical power storage devices **106**, and/or various components of a portable electrical energy storage device compartment of the all-electric scooter or motorbike **108**. The communications subsystem **206** may include one or more ports, wireless receivers, wireless transmitters or wireless transceivers to provide wireless signal paths to the various remote components or systems. The communications subsystem **206** may include one or more bridges or routers suitable to handle network traffic including switched packet type communications protocols (TCP/IP), Ethernet or other networking protocols.

The user interface subsystem **208** includes one or more user input/output (I/O) components. For example, user interface subsystem **208** may include a touch screen display **208***a* operable to present information to an end user, and a graphical user interface (GUI) to receive indications of user selections. The user interface subsystem **208** may include a keyboard or keypad **208***b*, and/or a cursor controller (e.g., mouse, trackball, trackpad) (not illustrated) to allow an end user to enter information and/or select user selectable icons in a GUI. The user interface subsystem **208** may include a speaker **208***c* to provide aural messages to an end user and/or a microphone **208***d* to receive spoken user input such as spoken commands.

The user interface subsystem **208** may include a card reader **208***e* to read information from card type media **209**. The card reader **208***e* may take a variety of forms. For instance, the card reader **208***e* may take the form of, or include, a magnetic stripe reader for reading information encoded in a magnetic stripe carried by a card **209**. For instance, the card reader **208***e* may take the form of, or include, a machine-readable symbol (e.g., barcode, matrix code) card reader for reading information encoded in a machine-readable symbol carried by a card **209**. For instance, the card reader **208***e* may take the form of, or include, a smart card reader for reading information encoded in a non-transitory medium carried by a card **209**. Such may, for instance, include media employing radio frequency identification (RFID) transponders or electronic payment chips (e.g., near field communications (NFC) chips, such as used by electronic wallet (e-wallet) applications, etc.). Thus, the card reader **208***e* may be able to read information from a variety of card media **209**, for instance credit cards, debit cards, gift cards, and prepaid cards, as well as identification media such as drivers licenses. The card reader **208***e* may also be able to read information encoded in a non-transitory medium carried by the portable electrical energy storage devices **106**, and may also include RFID transponders, transceivers, NFC chips and/or other communications devices to communicate information to various components of the all-electric scooter or motorbike **108**, various components of the portable electrical power storage devices **106**, and/or various components of a portable electrical energy storage device compartment of the all-electric scooter or motorbike **108** (e.g., for authentication of the collection, charging and distribution machine **102** to the portable electrical energy storage device compartment of the all-electric scooter or motorbike **108**, or for authentication of the of the all-electric scooter or motorbike **108** to the collection, charging and distribution machine **102**).

The user interface subsystem **208** may include a bill acceptor **208***f* and a validator and/or coin acceptor **208***g* to accept and validate cash payments. Such may be highly useful in servicing populations lacking access to credit. Bill acceptor and validator **208***f* and/or coin acceptor **208***g* may take any variety of forms, for example those that are currently commercially available and used in various vending machines and kiosks.

FIG. **3** shows a portable electrical energy storage device compartment locking system **300** for the portable electrical energy storage device of the scooter or motorbike **108** of FIG. **1** in wireless communication in one instance with the collection, charging and distribution machine **102** of FIG. **1** and in another instance with an external wireless device **308**, according to one non-limiting illustrated embodiment.

Shown is a portable electrical energy storage device compartment locking mechanism **320** operably coupled to a locking mechanism controller **306**. In some embodiments, the portable electrical energy storage device compartment locking mechanism **320** and the locking mechanism controller **306** are part of a portable electrical energy storage device compartment (shown in FIGS. **5**-**7**) of the scooter or motorbike **108**.

Also shown is the collection, charging and distribution machine **102** in wireless communication with the locking mechanism controller **306**. For example, the communications subsystem **206** (shown in FIG. **2**) of the collection, charging and distribution machine **102** may provide components enabling short range (e.g., via Bluetooth, near field communication (NFC), radio frequency identification (RFID) components and protocols) or longer range wireless communications (e.g., over a wireless LAN, satellite, or cellular network) with various other devices external to the collection, charging and distribution machine **102**, including the locking mechanism controller **306**. The communications subsystem **206** of the collection, charging and distribution machine **102** may include one or more ports, wireless receivers, wireless transmitters or wireless transceivers to provide wireless signal paths to the locking mechanism controller **306**. The communications subsystem **206** of the collection, charging and distribution machine **102** may also or instead include one or more bridges or routers suitable to handle network traffic including switched packet type communications protocols (TCP/IP), Ethernet or other networking protocols.

The portable electrical energy storage device **106***z* may be lent, leased, and/or rented out to the public. As the portable electrical energy storage devices **106** may be lent, leased, and/or rented out to the public, it is desirable to control how and in what circumstances the portable electrical energy storage device compartment for the portable electrical energy storage devices **106** may be accessed. This control of the access to the portable electrical energy storage device compartment of the portable electrical energy storage device **106***z* helps to prevent theft and/or misuse of the portable electrical energy storage device **106***z* and also provides for convenient access to the portable electrical energy storage device **106***z* when replacing or putting a new portable electrical energy storage device **106***z* in the scooter or motorbike **108** (such as when replacing the portable electrical energy storage device **106***z* with a new portable electrical energy storage device **106***z* at the collection, charging and distribution machine **102**. For example, the portable electrical energy storage device compartment may be empty and locked or otherwise secured until the locking mechanism controller **306** detects a wireless signal including authentication information from an external wireless device **308** or the collection, charging and distribution machine **102** with one or more wireless communications subsystems such as that described above with respect to the collection, charging and distribution machine **102**. Such external wireless devices including one or more wireless communications subsystems such as that described above with respect to the collection, charging and distribution machine **102** may include, but are not limited to: card keys, access cards, credit cards, access control key fobs, mobile computing devices, cellular telephones, personal digital assistants (PDAs), smart phones, battery chargers, other access control devices, etc.

For example, the wireless device **308** may periodically, constantly or aperiodically emit a wireless signal **118** for a locking mechanism controller **306** that is listening for such a signal to receive and authenticate the wireless device **308** in order to trigger the portable electrical energy storage device compartment locking mechanism **320** to automatically unlock or unlatch, conveniently enabling a new portable electrical energy storage device **106***z* to be operably placed in the portable electrical energy storage device compartment (shown in FIGS. **5**-**7**) of the scooter or bike **108**. Also or instead, the locking mechanism controller **306** may periodically or constantly emit a wireless signal **118** to the wireless device **308**. The wireless device **308** listening for such a signal will respond with a wireless signal for the locking mechanism controller **306** to receive and authenticate the wireless device **308** in order to trigger the portable electrical energy storage device compartment locking mechanism **320** to unlock or unlatch, conveniently enabling a new portable electrical energy storage device **106***z* to be operably placed in the portable electrical energy storage device compartment (shown in FIGS. **5**-**7**) of the scooter or bike **108**.

In some embodiments, the wireless signal received from the wireless device **308** may include a code that may be authenticated by the locking mechanism controller **306** in order to ensure the signal is being received from an authorized device. For example, the code may be time-sensitive code such as a “hopping” code or a “rolling” code to provide such security. In the case of a 40-bit rolling code, forty bits provide 240 (about 1 trillion) possible codes. However, codes of other bit lengths may be used instead. A wireless device **308** memory (e.g., ROM) may hold the current 40-bit code. The wireless device **308** then sends that 40-bit code to the locking mechanism controller **306** over the wireless signal **118** to unlock or unlatch the portable electrical energy storage device compartment locking mechanism **320**. The locking mechanism controller **306** also holds the current 40-bit code. If the locking mechanism controller **306** receives the 40-bit code it expects and the locking mechanism controller **306** detects the portable electrical energy storage device compartment is in a desired state to have the compartment unlocked, then it unlocks the portable electrical energy storage device compartment locking mechanism **320**. For example, if the locking mechanism controller **306** detects the portable electrical energy storage device compartment is empty then the portable electrical energy storage device compartment locking mechanism controller **306** unlocks the portable electrical energy storage device compartment locking mechanism **320**.

Also, in some embodiments, if the locking mechanism controller **306** detects the portable electrical energy storage device compartment is not empty, but detects a charge level of the portable electrical energy storage device in the portable electrical energy storage device compartment is below a particular threshold level (e.g., in instances where the portable electrical energy storage device likely needs to be recharged) then the portable electrical energy storage device compartment locking mechanism controller **306** unlocks the portable electrical energy storage device compartment locking mechanism **320**. This detection may be accomplished via a control line (e.g., control line **310**) that is operably connected to the portable electrical energy storage device and/or the portable electrical energy storage device detection device **528** that is configured to also detect a charge level of the portable electrical energy storage device in the compartment. In some embodiments, if the locking mechanism controller **306** receives the 40-bit code (or other authentication information) it expects in particular from the collection, charging and distribution machine **102** instead of another external device, and the portable electrical energy storage device charge level is below the particular threshold, then the portable electrical energy storage device compartment locking mechanism controller **306** unlocks the portable electrical energy storage device compartment locking mechanism **320** to enable the portable electrical energy storage device to be easily removed at the collection, charging and distribution machine **102**.

If the locking mechanism controller **306** does not receive the 40-bit code it expects or if the locking mechanism controller **306** detects the portable electrical energy storage device compartment is not in a desired state to have the compartment unlocked, the locking mechanism controller **306** does nothing. In some embodiments, the locking mechanism controller **306** will lock the portable electrical energy storage device compartment locking mechanism **320** if the portable electrical energy storage device compartment locking mechanism **320** is in an unlocked state and the locking mechanism controller **306** does not receive the 40-bit code it expects, or is not able to receive any signal over a determined period of time.

Both the wireless device **308** and the locking mechanism controller **306** use the same pseudo-random number generator (e.g., implemented by the respective processors of the collection, charging and distribution machine **102** and the locking mechanism controller **306**) to generate the 40-bit code. The wireless device **308** may have different pseudo-random number generators to match the pseudo-random number generator of each locking mechanism controller **306** of each portable electrical energy storage device compartment of each scooter or motorbike **108**. When the locking mechanism controller **306** receives a valid code from the wireless device **308**, it uses the same pseudo-random number generator to generate the next code relative to the valid code received and communicates wirelessly with the wireless device **308** to instruct it to also generate the next code using the same pseudo-random number generator, which the wireless device **308** stores for the next use. In this way, the wireless device **308** and the locking mechanism controller **306** are synchronized. The locking mechanism controller **306** only unlocks or unlatches the portable electrical energy storage device compartment locking mechanism **320** if it receives the code it expects.

Also, the current 40-bit code or other time-sensitive rolling code may be generated and communicated to one or more collection, charging and distribution machines within a network of collection, charging and distribution machines (e.g., via the network **122** shown in FIG. **1**) so that any collection, charging and distribution machine **102** may communicate the correct current code to the locking mechanism controller **306** when the scooter or motorbike having the locking mechanism controller **306** comes within wireless signal range of any authorized collection, charging and distribution machine.

In some embodiments, the wireless device **308** may accept any of the next 256 possible valid codes in the pseudo-random number sequence. This way, if the locking mechanism controller **306** and the wireless device **308** for some reason become unsynchronized by 256 rolling codes or less, the locking mechanism controller **306** would still accept the transmission from the wireless device **308**, detect that the portable electrical energy storage device compartment is empty, unlock the portable electrical energy storage device compartment locking mechanism **320**, and generate the next code relative to the valid code received.

In other embodiments, the hopping, rolling or time-sensitive code may be a universal code communicated by the back end or back office system **120** to the collection, charging and distribution machine **102** and communicated wirelessly to the locking mechanism controller **306**. For example, this may occur over a WAN, LAN and/or when the locking mechanism controller **306** comes within wireless communications range of the collection, charging and distribution machine **102** such as when the scooter or motorbike **108** visits the collection, charging and distribution machine **102**.

In some embodiments, the locking mechanism controller **306** and the wireless device **308** store a common secret key or code and use a common secret algorithm for authentication of the wireless device **308**. The common secret algorithm, for example, can be a hash function or other algorithm which takes the secret key and at least one other key or code as input and generates different output based on the secret key and different input. The common secret algorithm may be executed by respective processors of the locking mechanism controller **306** and the wireless device **308** using stored instructions on respective computer readable media of the locking mechanism controller **306** and the wireless device **308** or on respective configured hardware or firmware components of the of locking mechanism controller **306** and wireless device **308**. The common secret algorithm and common secret key or code may be initially encoded, programmed or installed in the locking mechanism controller **306** and wireless device **308** in a secure fashion such that they are irretrievable or otherwise protected from being discovered. The common secret algorithm and common secret key or code are not communicated between the locking mechanism controller **306** and wireless device **308** during the authentication process.

In response to receiving an authentication beacon or request from the wireless device **308** via the wireless signal **118** (which may have been sent in response to a wireless signal or beacon received from the locking mechanism controller **306**), the locking mechanism controller **306** generates a challenge key and sends this challenge key to the wireless device **308**. In response to receiving the challenge key, the wireless device **308** uses the secret algorithm and the common secret key to generate a response value and sends this response value to the locking mechanism controller **306**. The locking mechanism controller **306** then verifies the response value by using the generated challenge key and secret key as input to the secret algorithm to generate an output value from the secret algorithm. The locking mechanism controller **306** then compares this output value from the secret algorithm to the response value received from the wireless device **308**. If the output from the secret algorithm generated by the locking mechanism controller **306** and the response value received from the wireless device **308** match, then the wireless device **308** is authenticated and the locking mechanism controller **306** may then take actions accordingly, such as sending a control signal to the locking mechanism **320** to unlock. If the output from the secret algorithm generated by the locking mechanism controller **306** and the response value received from the wireless device **308** do not match, then the wireless device **308** is not authenticated and the locking mechanism controller **306** may then take no action, or take other actions accordingly, such as sending a control signal to the locking mechanism **320** to lock if not already locked.

In some embodiments, once the locking mechanism controller **306** can no longer receive the wireless signal **118** from the wireless device **308** and/or the collection, charging and distribution machine **102** (e.g., after the scooter or motorbike is no longer within range of the collection, charging and distribution machine **102** wireless signal **118**, or when the driver having the wireless device is no longer within range of the scooter or bike **108**), the locking mechanism controller **306** will send a signal to cause the portable electrical energy storage device compartment locking mechanism **320** to lock to prevent the portable electrical energy storage device **106***z* from being able to be removed from being operably connected to the scooter or motorbike **108**. Also, as described above, if the signal received from the wireless device **308**, the collection, charging and distribution machine **102** or other device contains an invalid code, if not already locked, the locking mechanism controller **306** will send a signal to cause the portable electrical energy storage device compartment locking mechanism **320** to lock to prevent the portable electrical energy storage device **106***z*, if present in the portable electrical energy storage device compartment, from being able to be removed from being operably connected to the scooter or motorbike, and if portable electrical energy storage device compartment is empty, prevent an unauthorized portable electrical energy storage device from being placed in the portable electrical energy storage device compartment. In some instances, the locking mechanism controller **306** must detect the presence of the portable electrical energy storage device **106***z* in the scooter or motorbike **108** before sending a signal to cause the portable electrical energy storage device compartment locking mechanism **320** to lock or latch.

FIG. **4** is a schematic view of the locking mechanism controller of FIG. **3**, according to one non-limiting illustrated embodiment.

The locking mechanism controller **306** includes a controller **410**, a communications subsystem **406**, and a power interface **420**.

The controller **410**, for example, is a microprocessor, microcontroller, programmable logic controller (PLC), programmable gate array (PGA), application specific integrated circuit (ASIC) or another controller capable of receiving signals from various sensors, performing logical operations, and sending signals to various components. Typically, the controller **410** may take the form of a microprocessor (e.g., INTEL, AMD, ATOM). The locking mechanism controller **306** may also include one or more non-transitory processor- or computer-readable storage media, for example read-only memory (ROM) **412**, random access memory (RAM) **414**, and other storage **416** (e.g., solid-state storage media such as flash memory or EEPROM, or spinning storage media such as hard disk). The non-transitory processor- or computer-readable storage media **412**, **414**, **416** may be in addition to any non-transitory storage medium (e.g., registers) which is part of the controller **410**. The locking mechanism controller **306** may include one or more buses **418** (only one illustrated) coupling various components together, for example one or more power buses, instruction buses, data buses, etc.

As illustrated, the ROM **412**, or some other one of the non-transitory processor- or computer-readable storage media **412**, **414**, **416**, stores instructions and/or data or values for variables or parameters. The sets of data may take a variety of forms, for example a lookup table, a set of records in a database, etc. The instructions and sets of data or values are executable by the controller **410**. Execution of the instructions and sets of data or values causes the controller **410** to perform specific acts to compare a code received from an external device and cause the locking mechanism controller **306** to generate control signals to lock or unlock the portable electrical energy storage device compartment locking mechanism **320** based on the comparison. Also, such acts may include, for example, operations implementing a pseudo-random number to generate a rolling code as described above. Specific operation of the locking mechanism controller **306** is described herein and also below with reference to various flow diagrams (FIGS. **8-10**).

The controller **410** may use RAM **414** in a conventional fashion, for volatile storage of instructions, data, etc. The controller **410** may use data store **416** to log or retain information, for example, information regarding user profile information, vehicle profile information, security codes, credentials, security certificates, passwords, vehicle information, etc. The instructions are executable by the controller **410** to control operation of the locking mechanism controller **306** in response to input from remote systems such as those of external devices including but not limited to: charging devices, vehicles, key fobs, user identification devices (cards, electronic keys, etc.) vehicles, collection, charging and distribution machines, collection, charging and distribution machine service systems, service centers, user mobile devices, user vehicles, and end user or operator input.

The controller **410** may also receive signals from various sensors and/or components of an external device via the communications subsystem **406** of the locking mechanism controller **306**. This information may include information that characterizes or is indicative of the authenticity, authorization level, operation, status, or condition of such components and/or external devices.

The communications subsystem **406** may include one or more communications modules or components which facilitate communications with the various components of the wireless device **308**, collection, charging and distribution machine **102** of FIG. **1** (e.g., such as to receive a security code) and/or of other external devices, such that data may be exchanged between the locking mechanism controller **306** and the external devices for authentication purposes. The communications subsystem **406** may provide wired and/or wireless communications. The communications subsystem **406** may include one or more ports, wireless receivers, wireless transmitters or wireless transceivers to provide wireless signal paths to the various remote components or systems. The communications subsystem **406** may, for example, include components enabling short range (e.g., via Bluetooth, near field communication (NFC), radio frequency identification (RFID) components and protocols) or longer range wireless communications (e.g., over a wireless LAN, satellite, or cellular network) and may include one or more modems or one or more Ethernet or other types of communications cards or components for doing so. The remote communications subsystem **406** may include one or more bridges or routers suitable to handle network traffic including switched packet type communications protocols (TCP/IP), Ethernet or other networking protocols.

In some embodiments, some or all of the components of the locking mechanism controller **306** actuate one or more actuators **502** (shown in FIG. **6** and FIG. **7**) of the portable electrical energy storage device compartment locking mechanism **320** (e.g., by a wireless control signal) sent via the communications subsystem **406**.

The power interface **420** is configured to receive power from a power source **516** (shown in FIGS. **5-7**) via connection **314** to provide power to the locking mechanism controller **306**. The power interface **420** includes various components operable for performing the above functions such as electrical transformers, converters, rectifiers, etc.

FIG. **5** shows cross-sectional elevation view of a locked, empty portable electrical energy storage device compartment **500** configured to hold the portable electrical energy storage device **106***z* of FIG. **1** and FIG. **3** coupled to the portable electrical energy storage device compartment locking system **300** of FIG. **3**, according to one non-limiting illustrated embodiment.

Shown is a portable electrical energy storage device compartment housing **512**, a part of a vehicle **508**, a portable electrical energy storage device compartment locking mechanism **320**, a locking mechanism controller **306** and a power source **516**. In one embodiment, the portable electrical energy storage device compartment locking mechanism **320** is located outside the portable electrical energy storage device compartment housing **512** and fixed to a part of the vehicle **508** (as shown in the example of FIG. **5**). In other embodiments, the portable electrical energy storage device locking mechanism **320** is located inside or otherwise fixed to the portable electrical energy storage device compartment housing **512** and/or vehicle. In each embodiment, however, the portable electrical energy storage device locking mechanism **320** is configured to lock, latch, unlock and/or unlatch, or otherwise secure or provide access to the portable electrical energy storage device compartment **500**.

For example, the portable electrical energy storage device compartment **500** has a top opening through which the portable electrical energy storage device **106***z* may be placed into the portable electrical energy storage device compartment **500** and removed from the portable electrical energy storage device compartment **500**. Once the portable electrical energy storage device **106***z* is placed in the portable electrical energy storage device compartment **500**, the portable electrical energy storage device compartment housing **512** surrounds the portable electrical energy storage device **106***z* except at the top opening. As shown in FIG. **5**, the portable electrical energy storage device compartment **500** has a lid **520** covering the top opening of the portable electrical energy storage device compartment **500**. The lid **420** is hingedly attached to the top of a side wall **522** of the portable electrical energy storage device compartment **500** at a hinge **524** such that when the lid **520** is opened, a portable electrical energy storage device **106***z* may be placed in the portable electrical energy storage device compartment **500** or removed from the portable electrical energy storage device compartment **500**.

The portable electrical energy storage device compartment locking mechanism **320** has a slidable bolt **506** which partially covers an end of the lid **520** opposite the hinge **524** when the lid **520** is in a closed position as shown in FIG. **5**. This puts the portable electrical energy storage device compartment **500** in a locked or latched state by blocking the lid **520** from moving upward on the hinge **524** to an open position. The slidable bolt **506** is slidable on a bolt track or through bolt housing **504** fixedly attached to the vehicle part **508**. However, in other embodiments, the bolt housing **504** may be fixedly attached to the compartment housing **512**. When the portable electrical energy storage device compartment locking mechanism **320** is in an unlocked state, the slidable bolt **506** is retracted into the bolt housing **504** to not cover any portion of the lid **520** and thus allow the lid **520** to be opened (as shown in FIG. **6**).

The portable electrical energy storage device compartment locking mechanism **320** is coupled to the locking mechanism controller **306** via a control line **308** and coupled to the power source via power line **526**. For example, one or more control signals received from the locking mechanism controller **306** via control line **308** may affect the operation of one or more actuators **502** (only one illustrated) to cause the slidable bolt **506** to move. For instance, a control signal may cause movement of an actuator **502** between a first and a second position or change a magnetic field produced by the actuator **502**. The actuator **502** may take any of a variety of forms, including but not limited to a solenoid, an electric motor such as a stepper motor, or an electromagnet. The actuator **502** may alternatively be coupled to operate a different latch, lock or other type of retainer mechanism for reversibly locking the portable electrical energy storage device compartment lid **520**.

The actuator **502** may be coupled to operate a latch, lock or other retainer mechanism (not shown) in addition to or instead of the bolt **506**. The latch, lock or other retainer mechanism may selectively secure or retain the lid **520** to prevent access to the portable electrical energy storage device compartment **500**. For instance, the latch, lock or other retainer mechanism may physically couple to a complimentary structure that is part of the housing **512** or the lid **520** of the portable electrical energy storage device compartment **500**. Also for example, the actuator **502** may open and/or close a different latch or lock, allowing an end user to open the lid **520** or allowing the lid **520** to open automatically via a spring or other device.

The compartment housing **512** may provide protection to prevent or deter tampering with the electrical energy storage device, and may be formed of suitably strong and resilient materials (e.g., ABS plastic). Such may not only prevent or deter tampering, but may leave a visible indication of any tampering attempts. For example, the housing **512** may include a strong outer layer of a first color (e.g., black) and a layer of a second color (e.g., fluorescent orange) therebeneath. Such will render attempts to cut through the housing **512** visibly apparent.

The locking mechanism controller **306** is coupled to a switch or other portable electrical energy storage device detection device **528** via control line(s) **310**. In the example embodiment shown in FIG. **5**, the portable electrical energy storage device detection device **528** is a button **530** supported by a spring **532** situated within the interior bottom of the housing **512**. The button **530** supported by the spring **532** is configured to, when pressed down, cause a closed circuit or open circuit condition to occur involving the control line(s) **310**. The locking mechanism controller **306** detects such a condition on control line(s) **310** such that the locking mechanism controller **306** may control operation of the portable electrical energy storage device locking mechanism **320** accordingly. For example, when a portable electrical energy storage device **106***z* is placed in the portable electrical energy storage device compartment **500**, the button **530** and supporting spring **532** are configured such that the weight of the portable electrical energy storage device **106***z* causes the button **530** to be pressed down and cause a closed circuit or open circuit condition to occur, e.g., via a conductive material (not shown) on the bottom of the button **530** coming into electrical contact with the control line(s) **310**. An example of this state is shown in FIG. **7**.

When the portable electrical energy storage device **106***z* is removed from the portable electrical energy storage device compartment **500**, the button **530** and supporting spring **532** are configured such that the supporting spring **532** pushes the button **530** back into a position above the interior bottom planar surface of the compartment housing **512**, thus causing a closed circuit or open circuit condition to occur opposite of that when the button **530** is in the pressed down state. In this manner, the locking mechanism controller **306** may detect when the portable electrical energy storage device **106***z* is present in the portable electrical energy storage device compartment **500**. However, other mechanical, electric and/or electronic detection devices may be used that provide the locking mechanism controller **306** with an indication of whether the portable electrical energy storage device **106***z* is present in the portable electrical energy storage device compartment **500**.

FIG. **6** shows a cross-sectional elevation view of the empty portable electrical energy storage device compartment of FIG. **5** in an unlocked and open state, according to one non-limiting illustrated alternative embodiment.

For example, if the portable electrical energy storage device compartment **500** were in the state shown in FIG. **5** (i.e., in a locked state without a portable electrical energy storage device detected by the detection mechanism **528** as being present in the portable electrical energy storage device compartment **500**), once the locking mechanism controller **306** receives information regarding authentication of a wireless external device (e.g., a driver's key fob or other wireless device), the locking mechanism controller **306** will cause the portable electrical energy storage device locking mechanism **320** to automatically unlock or unlatch the lid **520** to allow the lid **520** to be opened as shown in FIG. **6**.

FIG. **7** shows a cross-sectional elevation view of the portable electrical energy storage device compartment **500** of FIG. **5** in a locked state holding the portable electrical energy storage device **106***z* of FIG. **1** and FIG. **3**, according to one non-limiting illustrated alternative embodiment.

For example, in FIG. **7**, the portable electrical energy storage device compartment **500** is in a locked state, but the portable electrical energy storage device **106***z* is present in the portable electrical energy storage device compartment **500**. The locking mechanism controller **306** detects the presence of the portable electrical energy storage device **106***z* by the button **530** being in a pressed down state. The button **530** is configured such that the weight of the portable electrical energy storage device **106***z* causes the button **530** to be pressed down and cause a closed circuit or open circuit condition to occur, e.g., via a conductive material (not shown) on the bottom of the button **530** coming into electrical contact with the control line(s) **310**. This closed circuit or open circuit condition is opposite of the closed circuit or open circuit condition that occurs when the button **530** is not pressed down (as shown in FIGS. **5** and **6**). When the portable electrical energy storage device compartment is in the state **500** shown in FIG. **7** (i.e., in a locked state with the portable electrical energy storage device **106***z* present in the portable electrical energy storage device compartment **500**), even if the locking mechanism controller **306** receives information regarding authentication of a wireless external device (e.g., a driver's key fob or other wireless device), the locking mechanism controller **306** will not cause the portable electrical energy storage device locking mechanism **320** to automatically unlock or unlatch the lid **520** to allow the lid **520** to be opened as shown in FIG. **6** without further authentication or use of a key, etc. This is because if there is a portable electrical energy storage device **106***z* in the portable electrical energy storage device compartment **500** and a user comes within the vicinity of the portable electrical energy storage device compartment **500** with their authorized wireless device, it is less likely that the user needs to access the portable electrical energy storage device compartment **500** than if the portable electrical energy storage device compartment **500** were empty.

However, in some embodiments, alternatively or additionally, if the locking mechanism controller **306** detects the portable electrical energy storage device compartment is not empty, but detects a charge level of the portable electrical energy storage device in the portable electrical energy storage device compartment is below a particular threshold level (e.g., in instances where the portable electrical energy storage device likely needs to be recharged) then the portable electrical energy storage device compartment locking mechanism controller **306** unlocks the portable electrical energy storage device compartment locking mechanism **320**. This detection may be accomplished via a control line (e.g., control line **310**) that is operably connected to the portable electrical energy storage device and/or the portable electrical energy storage device detection device **528** that may be configured to also detect a charge level of the portable electrical energy storage device in the compartment **500**.

In some embodiments, when the portable electrical energy storage device compartment is in the state **500** shown in FIG. **7** (i.e., a locked state with the portable electrical energy storage device **106***z* present in the portable electrical energy storage device compartment **500**), the locking mechanism controller **306** may be in a state in which it is not listening for such a signal including information regarding authentication of a wireless external device. However, if the portable electrical energy storage device compartment **500** changes to the state shown in FIG. **5** (i.e., a locked state without a portable electrical energy storage device **106***z* detected by the detection mechanism **528** as being present in the portable electrical energy storage device compartment **500**), the locking mechanism controller **306** may switch to be in a state in which it is listening for such a signal including information regarding authentication of a wireless external device.

Also note that the lid **520** may have openings or holes to allow the terminals **110***a* and **110***b* of the portable electrical energy storage device **106***z* to be accessed when the portable electrical energy storage device **106***z* is present and locked in the portable electrical energy storage device compartment **500**, such that the terminals **110***a* and **110***b* may be operably connected to a vehicle such as the scooter or bike **108** to power the vehicle.

FIG. **8** shows a high level method **800** of operating the locking mechanism controller **306** of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment.

At **802**, the portable electrical energy storage device compartment locking system receives information regarding authentication of an external device via the communications module.

At **804**, the portable electrical energy storage device compartment locking system determines whether a compartment configured to hold a portable electrical energy storage device is in a desired state to have the compartment unlocked.

At **806**, if it is determined the compartment is in the desired state to have the compartment unlocked, unlock a portable electrical energy storage device compartment locking mechanism of the compartment.

FIG. **9** shows a low level method **900** of operating the locking mechanism controller of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment, including communicating information to unlock the portable electrical energy storage device compartment locking mechanism, useful in the method of FIG. **8**.

At **902**, the portable electrical energy storage device compartment locking system receives the information regarding authentication of the external device via a wireless signal and communicates the information to the at least one controller to enable the at least one controller to unlock the portable electrical energy storage device compartment locking mechanism.

FIG. **10** shows a high level method **1000** of operating the portable electrical energy storage device compartment system of FIGS. **3**-**7**, according to one non-limiting illustrated embodiment.

At **1002**, the portable electrical energy storage device compartment locking system receives information regarding authentication of an external device.

At **1004** the portable electrical energy storage device compartment locking system makes a determination regarding unlocking a portable electrical energy storage device compartment locking mechanism to allow the compartment to be opened. This determination is based on the information regarding authentication and based on a detection of an absence of a portable electrical energy storage device in a compartment configured to hold the portable electrical energy storage device.

The various methods described herein may include additional acts, omit some acts, and/or may perform the acts in a different order than set out in the various flow diagrams.

The foregoing detailed description has set forth various embodiments of the devices and/or processes via the use of block diagrams, schematics, and examples. Insofar as such block diagrams, schematics, and examples contain one or more functions and/or operations, it will be understood by those skilled in the art that each function and/or operation within such block diagrams, flowcharts, or examples can be implemented, individually and/or collectively, by a wide range of hardware, software, firmware, or virtually any combination thereof. In one embodiment, the present subject matter may be implemented via one or more microcontrollers. However, those skilled in the art will recognize that the embodiments disclosed herein, in whole or in part, can be equivalently implemented in standard integrated circuits (e.g., Application Specific Integrated Circuits or ASICs), as one or more computer programs executed by one or more computers (e.g., as one or more programs running on one or more computer systems), as one or more programs executed by on one or more controllers (e.g., microcontrollers) as one or more programs executed by one or more processors (e.g., microprocessors), as firmware, or as virtually any combination thereof, and that designing the circuitry and/or writing the code for the software and/or firmware would be well within the skill of one of ordinary skill in the art in light of the teachings of this disclosure.

When logic is implemented as software and stored in memory, logic or information can be stored on any nontransitory computer-readable medium for use by or in connection with any processor-related system or method. In the context of this disclosure, a memory is a nontransitory computer- or processor-readable storage medium that is an electronic, magnetic, optical, or other physical device or means that non-transitorily contains or stores a computer and/or processor program. Logic and/or the information can be embodied in any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions associated with logic and/or information.

In the context of this specification, a "computer-readable medium" can be any physical element that can store the program associated with logic and/or information for use by or in connection with the instruction execution system, apparatus, and/or device. The computer-readable medium can be, for example, but is not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus or device. More specific examples (a non-exhaustive list) of the computer readable medium would include the following: a portable computer diskette (magnetic, compact flash card, secure digital, or the like), a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM, EEPROM, or Flash memory), a portable compact disc read-only memory (CDROM), and digital tape.

The various embodiments described above can be combined to provide further embodiments. To the extent that they are not inconsistent with the specific teachings and definitions herein, all of the U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet, including but not limited to: U.S. provisional patent application Ser. No. 61/511,900 entitled "APPARATUS, METHOD AND ARTICLE FOR COLLECTION, CHARGING AND DISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/647,936 entitled "APPARATUS, METHOD AND ARTICLE FOR COLLECTION, CHARGING AND DISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES" and filed May 16, 2012, U.S. provisional patent application Ser. No. 61/534,753 entitled "APPARATUS, METHOD AND ARTICLE FOR REDISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES, BETWEEN COLLECTION, CHARGING AND DISTRIBUTION MACHINES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/534,761 entitled "APPARATUS, METHOD AND ARTICLE FOR AUTHENTICATION, SECURITY AND CONTROL OF POWER STORAGE DEVICES SUCH AS BATTERIES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/534,772 entitled "APPARATUS, METHOD AND ARTICLE FOR AUTHENTICATION, SECURITY AND CONTROL OF POWER STORAGE DEVICES, SUCH AS BATTERIES, BASED ON USER PROFILES" and filed Sep. 14, 2011, U.S. provisional patent application Ser. No. 61/511,887 entitled "THERMAL MANAGEMENT OF COMPONENTS IN ELECTRIC MOTOR DRIVE VEHICLES" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/647,941 entitled "THERMAL MANAGEMENT OF COMPONENTS IN ELECTRIC MOTOR DRIVE VEHICLES" and filed May 16, 2012, U.S. provisional patent application Ser. No. 61/511,880 entitled "DYNAMICALLY LIMITING VEHICLE OPERATION FOR BEST EFFORT ECONOMY" and filed Jul. 26, 2011, U.S. provisional patent application Ser. No. 61/557,170 entitled "APPARATUS, METHOD, AND ARTICLE FOR PHYSICAL SECURITY OF POWER STORAGE DEVICES IN VEHICLES" and filed Nov. 8, 2011, U.S. provisional patent application Ser. No. 61/581,566 entitled APPARATUS, METHOD AND ARTICLE FOR A POWER STORAGE DEVICE COMPARTMENT' and filed Dec. 29, 2011, U.S. provisional patent application Ser. No. 61/601,404 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING VEHICLE DIAGNOSTIC DATA" and filed Feb. 21, 2012, U.S. provisional patent application Ser. No. 61/601,949 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING LOCATIONS OF POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINES" and filed Feb. 22, 2012, and U.S. provisional patent application Ser. No. 61/601,953 entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING INFORMATION REGARDING AVAILABILITY OF POWER STORAGE DEVICES AT A POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINE" and filed Feb. 22, 2012, U.S. application Ser. No. 13/559,314, filed on Jul. 26, 2012, naming Hok-Sum Horace Luke, Matthew Whiting Taylor and Huang-Cheng Hung as inventors and entitled "APPARATUS, METHOD AND ARTICLE FOR COLLECTION, CHARGING AND DISTRIBUTING POWER STORAGE DEVICES, SUCH AS BATTERIES", U.S. application Ser. No. 13/559,038, filed on Jul. 26, 2012, naming Hok-Sum Horace Luke and Matthew Whiting Taylor as inventors and entitled "APPARATUS, METHOD AND ARTICLE FOR AUTHENTICATION, SECURITY AND CONTROL OF POWER STORAGE DEVICES SUCH AS BATTERIES" U.S. application Ser. No. 13/559,264, filed on Jul. 26, 2012 naming Hok-Sum Horace Luke and Matthew Whiting Taylor as inventors and entitled "DYNAMICALLY LIMITING VEHICLE OPERATION FOR BEST EFFORT ECONOMY", U.S. application Ser. No. 13/559,054, filed on Jul. 26, 2012, naming Matthew Whiting Taylor, Yi-Tsung Wu, Hok-Sum Horace Luke and Huang-Cheng Hung as inventors and entitled "APPARATUS, METHOD, AND ARTICLE FOR PHYSICAL SECURITY OF POWER STORAGE DEVICES IN VEHICLES", U.S. application Ser. No. 13/559,390, filed on Jul. 26, 2012, naming Ching Chen, Hok-Sum Horace Luke, Matthew Whiting Taylor, Yi-Tsung Wu as inventors and entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING VEHICLE DIAGNOSTIC DATA", U.S. application Ser. No. 13/559,343, filed on Jul. 26, 2012, naming Yi-Tsung Wu, Matthew Whiting Taylor, Hok-Sum Horace Luke and Jung-Hsiu Chen as inventors and entitled "APPARATUS, METHOD AND ARTICLE FOR PROVIDING INFORMATION REGARDING AVAILABILITY OF POWER STORAGE DEVICES AT A POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINE", and U.S. application Ser. No. 13/559,064, filed on Jul. 26, 2012, naming Hok-Sum Horace Luke, Yi-Tsung Wu, Jung-Hsiu Chen, Yulin Wu, Chien Ming Huang, TsungTing Chan, Shen-Chi Chen and Feng Kai Yang as inventors and entitled "APPARATUS, METHOD AND ARTICLE FOR RESERVING POWER STORAGE DEVICES AT RESERVING POWER STORAGE DEVICE COLLECTION, CHARGING AND DISTRIBUTION MACHINES" are incorporated herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary, to employ systems, circuits and concepts of the various patents, applications and publications to provide yet further embodiments.

While generally discussed in the environment and context of collection, charging and distribution of portable electrical energy storage devices for use with personal transportation vehicles such as all-electric scooters and/or motorbikes, the teachings herein can be applied in a wide variety of other environments, including other vehicular as well as non-vehicular environments.

The above description of illustrated embodiments, including what is described in the Abstract of the Disclosure, is not intended to be exhaustive or to limit the embodiments to the precise forms disclosed. Although specific embodiments and examples are described herein for illustrative purposes, various equivalent modifications can be made without departing from the spirit and scope of the disclosure, as will be recognized by those skilled in the relevant art.

These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

We claim:

1. A portable electrical energy storage device compartment system, comprising:
- at least one controller; and
- at least one communications module coupled to the at least one controller, wherein the at least one controller is configured to:
  - receive information regarding authentication of an external device via the at least one communications module; and
  - in response to receiving the information regarding authentication:
    - determine whether a compartment configured to hold a portable electrical energy storage device is in a desired state to have the compartment unlocked, wherein the desired state to have the compartment unlocked is a state in which the portable electrical energy storage device is present in the compartment and a charge level of the portable electrical energy storage device is below a particular threshold; and
    - if it is determined the compartment is in the desired state to have the compartment unlocked, unlock a portable electrical energy storage device compartment locking mechanism of the compartment.

2. The portable electrical energy storage device compartment system of claim **1** wherein the external device is a portable electrical energy storage device collection and charging machine.

3. The portable electrical energy storage device compartment system of claim **1**, wherein the at least one communications module is configured to receive the information regarding authentication of the external device via a wireless signal and communicate the information to the at least one controller to enable the at least one controller to unlock the portable electrical energy storage device compartment locking mechanism.

4. The portable electrical energy storage device compartment system of claim **1**, further comprising:
- the portable electrical energy storage device compartment locking mechanism coupled to the at least one controller; and
- a detection device coupled to the at least one controller and the compartment, the detection device configured to be activated by the portable electrical energy storage device being present in the compartment, wherein the at least one controller is configured to send a control signal in a manner to unlock the portable electrical energy storage device compartment locking mechanism in order to allow the compartment to be opened, if the external device is authenticated based on the information regarding authentication.

5. The portable electrical energy storage device compartment system of claim **1** wherein the at least one controller is further configured to make a determination regarding unlocking the portable electrical energy storage device compartment locking mechanism based on the received information regarding authentication.

6. The portable electrical energy storage device compartment system of claim **5** wherein the least one controller is further configured to:
- generate a challenge key to send to the external device;
- send the challenge key to the external device;
- receive a response from the external device to the sending of the challenge key, the response including a response code as part of the information regarding authentication;
- generate an output from a secret algorithm using a secret key and the response code as input, the secret algorithm and the secret key configured to be known only to the portable electrical energy storage device compartment system and one or more authorized external devices; and
- comparing the output from the secret algorithm to the response code, and wherein the at least one controller is configured to make the determination regarding unlocking the portable electrical energy storage device compartment locking mechanism based at least on the comparison.

7. The portable electrical energy storage device compartment system of claim **1** wherein the configured portable electrical energy storage device compartment system is coupled to a vehicle.

8. The portable electrical energy storage device compartment system of claim **1** wherein the external device is a key fob.

9. The portable electrical energy storage device compartment system of claim **1** wherein the external device is a wireless portable electronic device.

10. The portable electrical energy storage device compartment system of claim **1** wherein the external device is a device located at a vehicle service center.

11. The portable electrical energy storage device compartment system of claim **1** wherein the at least one controller is configured to receive the information regarding authentication via a wireless signal transmitted from the external device, and wherein the wireless signal transmitted from the external device is not detectable outside a specified maximum range from the at least one communications module.

12. The portable electrical energy storage device compartment system of claim **11** wherein the wireless signal includes a rolling code for the authentication of the external device by the at least one controller.

13. The portable electrical energy storage device compartment system of claim **1** further comprising a power source coupled to the at least one controller and the portable electrical energy storage device compartment locking mechanism to provide power to the portable electrical energy storage device compartment locking mechanism.

14. A method of operating a portable electrical energy storage device compartment system, the method comprising:
- receiving, by the portable electrical energy storage device compartment system, information regarding authentication of an external device; and
- making a determination, by the portable electrical energy storage device compartment system, regarding unlocking a portable electrical energy storage device compartment locking mechanism, based on the information regarding authentication and based on a detection of an absence of a portable electrical energy storage device in a compartment configured to hold the portable electrical

energy storage device and whether a charge level of the portable electrical energy storage is below a particular threshold.

15. The method of claim **14** further comprising:

detecting the absence of the portable electrical energy storage device in the compartment by determining that the portable electrical energy storage device is not present in the compartment based on an absence of a signal from a detection device coupled to the compartment configured to be activated by the presence of the portable electrical energy storage device in the compartment.

16. The method of claim **14** wherein the receiving the information regarding authentication includes receiving the information regarding authentication via a wireless signal transmitted from a portable wireless electronic device, and wherein the wireless signal received from the portable wireless electronic device is not detectable outside a specified maximum range from a communications module of the portable electrical energy storage device compartment system.

17. The method of claim **14** wherein the portable electrical energy storage device compartment system is coupled to a vehicle to which the portable electrical energy storage device is configured to provide power when the portable electrical energy storage device is present in the compartment.

18. The method of claim **14** wherein the making the determination includes comparing a code from the received information regarding authentication to one or more codes associated with the portable electrical energy storage device compartment system and further comprising:

unlocking the portable electrical energy storage device compartment locking mechanism to allow the compartment to be opened if the code from the received information regarding authentication matches one of the one or more codes associated with the portable electrical energy storage device compartment system and there is an absence of the portable electrical energy storage device in the compartment detected.

19. The method of claim **18** further comprising:

automatically lifting a lid of the compartment if the code from the received information regarding authentication matches the one of the one or more codes associated with the portable electrical energy storage device compartment system and there is an absence of the portable electrical energy storage device in the compartment detected.

20. A portable electrical energy storage device compartment, comprising:

a housing configured to hold a portable electrical energy storage device;

a power source; and

a portable electrical energy storage device compartment locking system coupled to the power source and the housing configured to allow the compartment to be opened based on information regarding authentication of an external device received wirelessly from the external device and based on a detection of a desired state to have the compartment unlocked, wherein the desired state to have the compartment unlocked is a state in which the portable electrical energy storage device is not present in the compartment and a charge level of the portable electrical energy storage device is below a particular threshold.

21. The portable electrical energy storage device compartment of claim **20** wherein the portable electrical energy storage device compartment locking system comprises:

at least one controller; and

at least one communications module coupled to the at least one controller, wherein the at least one controller is configured to:

receive the information regarding authentication of an external device via the at least one communications module;

receive information regarding the detection of an absence of a portable electrical energy storage device in the housing; and

make a determination regarding unlocking the portable electrical energy storage device compartment locking system to allow the compartment to be opened based on the received information regarding authentication of an external device via the at least one communications module and based on the received information regarding the detection of an absence of a portable electrical energy storage device in the housing.

22. The portable electrical energy storage device compartment of claim **21** wherein the housing configured to hold the portable electrical energy storage device is coupled to a vehicle to which the portable electrical energy storage device is configured to provide power when the portable electrical energy storage device is present in the housing.

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